AN AMENDMENT TO THE MASTER DRAINAGE DEVELOPMENT PLAN FOR WATERVIEW

WATERVIEW NORTH

EL PASO COUNTY, COLORADO

October 2020

PREPARED FOR:

CPR Entitlements, LLC

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PROJECT NO. 02-19-05

PCD File No. SKP202

CERTIFICATIONS

Design Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. This drainage report has been prepared to satisfy criteria established and set forth by El Paso County for drainage reports. This drainage report is in conformance with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Charles K. Cothern, P.E. #24997

Seal

Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

By (signature):
By (signature):

Date:

Title: <u>CPR Entitlements, LLC</u>

P.A. Koscielski, Manager

Address: <u>31 N. Tejon, Suite 500</u>

Colorado Springs, CO 80903

El Paso County:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

Jennifer Irvine, P.E., County Engineer / ECM Administrator Date

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INTRODUCTION

Waterview North is a proposed multi-use development located within the greater Waterview Subdivision, in El Paso County, Colorado. The Waterview North site encompasses approximately 116.5 acres of development that include Industrial, Commercial and Residential uses with varying density.

Purpose & Scope of Study

This report is presented in conjunction with the Sketch Plan Amendment for Waterview as an Amendment to the Master Drainage and Development Plan for Waterview. Improvements proposed as part of Waterview North, Phase III of development on the Waterview Sketch Plan Amendment, are included as reference material in Appendix B. The purpose of this Amendment is to append findings presented with previously approved MDDP Amendments as well as the original Master Development and Drainage Plan (MDDP) for Waterview. Proposed changes to Land Use associated with the Amended Sketch Plan for Waterview are accompanied by updated hydrology calculations, updated Water Quality and Detention Pond Designs, and updated hydraulic calculations. Developments shown on the referenced, Amended Sketch Plan for Waterview are proposed in a manner that satisfies the requirements and criteria set forth by El Paso County's Engineering Criteria Manual as well as Volumes 1 and 2 of the Drainage Criteria Manual. Runoff quantities and proposed facilities have been calculated and sized using current El Paso County Development Standards and Drainage Criteria.

GENERAL DESCRIPTION AND LOCATION

Waterview North is located within the Waterview Subdivision, which encompasses approximately 721.8 acres. Waterview North occupies approximately 116.5 acres of the Northeast corner of the Waterview Sketch Plan. The Southwest Corner of the property coincides with the Northeast Corner of the intersection at Powers Boulevard and Bradley Road, in El Paso County, Colorado. The site is bound on the west and south by Powers Boulevard and Bradley Road, respectively. The Colorado Springs Airport lies to north, beyond a 3400' swath of undeveloped property. The Colorado Springs City Limits coincide with the northern boundary of Waterview North. The eastern boundary of the site and the Widefield Transportation Center D3 to the east are separated by a 1200-foot wide swath of undeveloped land and Foreign Trade Zone Blvd.

Of the 116.5 acres that is Waterview North, Residential accounts for 69 acres, Industrial covers 28.5 acres and Commercial occupies 18.6 acres.

Climate

The climate of the site is typical of a sub-humid to semiarid climate with mild summers and winters. The average temperature is 31F degrees in the winter and 68.4F degrees in the summer. Total annual precipitation is 15.21 inches.

Floodplain Statement

The Flood Insurance Rate Map (FIRM No. 08041C 0768G dated 12/07/2018) indicates that there is no floodplain in the vicinity of the proposed site. Please refer to the Annotated FIRM Panel, located in Appendix A at the back of this report.

Utilities & Other Encumbrances

There is an existing petroleum line that runs north / south on the westerly portion of Waterview North, along the inside of the eastern boundary of the Powers Boulevard easement. Said gas line is reflected on the plans and drainage exhibits.

There is a pair of existing 42" CMP culverts that cross Bradley Road approximately 950 feet to the east of the intersection at Powers Boulevard.

There are above-ground power lines that cross Bradley Road and follow the eastern boundary of the site. Distribution lines exist among said group of above-ground power lines.

Referenced Drainage Studies

Waterview North occupies the northeast quadrant of the greater Waterview Subdivision and straddles two major drainage basins as identified by El Paso County. A DBPS for each of the 2 major basins were referenced in addition to two Final Drainage Reports for nearly adjacent portions of the Waterview Subdivision and one Amendment to the MDDP for Waterview. A listing of the referenced Studies and Reports is as follows:

- Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives and Design of Selected Plan Report", by Kiowa Engineering, dated March 2015.
- *West Fork Jimmy Camp Creek Drainage Basin Planning Study"*, by Kiowa Engineering, dated October 2003.
- *"Amendment to the MDDP for Waterview ",* completed by Springs Engineering and approved in July of 2014.
- *"Final Drainage Report for Trails at Aspen Ridge, Filing No. 1",* completed by Matrix Design Group and approved in January of 2020.
- *"Final Drainage Report for Trails at Aspen Ridge, Filing No. 2",* completed by Matrix Design Group and approved in February of 2020.

SOIL CONDITIONS

Soils that underly the project site and the site's offsite tributary areas are analyzed and classified by their by Hydrologic Soil Type. Soils can be classified into four different hydrologic groups; A, B, C, & D. This manner of classification is applied to account for a soils' potential to produce runoff. Hydrologic group "A" is characterized by well-drained coarse-grained soils that have high infiltration rates and high rates of saturated hydraulic conductivity. Type "A" soils have low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock. As such, Type D soils have very slow infiltration rates and a high runoff potential. Please refer to the Soils Map, included in Appendix A. The table on the following page summarizes site soils by Hydrologic Type.

Pre-Development site conditions may be described as undeveloped high desert terrain having sparse natural vegetative cover (\leq 50% cover) consisting of brush, weeds and grass with brush being the most abundant. About a third of onsite soils are classified as type A. It should be noted that post development consideration of onsite areas does not recognize type A soil. All type A soils, onsite, are to be

considered as Type B Soils for post development conditions. The following is a summary table which lists the various soils of which the site is comprised:

Map Unit	Map Unit	Hydrologic	Acreage of	Percentage of
Symbol	Name	Soil Type	AOI	AOI
	Blakeland loamy sand,			
8	1 to 9 % slopes	А	43.7	32.50%
	Fort Collins loam,			
31	3 to 8 % slopes	В	33.2	24.70%
	Nelson-Tassel fine sandy loams			
56	3 to 18% slopes	В	33.4	24.80%
	Stoneham sandy loam,			
86	3 to 8 % slopes	В	19.8	14.70%
	Truckton loamy sand, 1			
95	to 9% slopes	А	0.2	0.10%
	Wiley silt loam, 3 to 9			
108	% slopes	В	4.4	3.30%
		Totals for Area of		
		Interest	134.7	100%

Site Soil Summary Table

DRAINAGE BASINS & SUB-BASINS

The Waterview North development site is located within 2 major drainage basins; Big Johnson/Crews Gulch and Jimmy Camp Creek. The sites location lies in the upper reaches of each of the mentioned major watersheds. Portions of the site that belong to the Big Johnson/Crews Gulch Basin Tributary occupy western and northwestern reaches of the property. The western portion of the offsite tributary to Waterview North also belongs to the Big Johnson/Crews Gulch Basin Tributary. A portion of the site that covers the western boundary of Waterview North, characterized as Basin BJD-EX14 on the Pre-Dev Basin Map, located in Appendix B, presently drains to the west, over and across Powers Boulevard and ultimately into Big Johnson/Crews Gulch Basin. CDOT construction of Powers Boulevard Improvements will result in a hydraulic barrier to surface runoff generated over Basin BJD-EX14, as it presently conveys. Post Development conditions refer to the subject area as Basin BJDEV-14. While runoff generated over Basin BJDEV14 will not continue to convey in historic fashion as surface flow that crosses Powers Blvd., it is assumed that construction of the Powers Blvd. Improvements will maintain the historic drainage pattern in some form or fashion, and Basin BJDEV14 runoff will continue to convey to Big Johnson/Crews Gulch Basin. Post development conditions for this site consider this basin as undeveloped since construction of CDOT improvements to Powers will likely predate its development into a commercial property.

The remainder of Waterview North lies within one of two sub-basins belonging to the Jimmy Camp Creek Tributary. A 10-acre piece that occupies the southwest corner of the property is part of the West Fork Tributary to Jimmy Camp Creek. The remainder of the site, as well as the eastern portion of the offsite tributary are part of the MarkSheffel Tributary to Jimmy Camp Creek.

Basin IDs used in this study agree with those established for each of the Tributaries in the reference material. Areas ultimately tributary to Big Johnson/Crews Gulch Basin are labelled with a "BJD"

prefix, those tributary to Jimmy Camp Creek have a "JCD" prefix. Concentration points and Ponds are all labelled to be consistent with the reference material with the exception of Design Pt. A, which corresponds to Design Point "1-OS" as referenced from the Final Drainage Reports for Trails at Aspen Ridge, Filing No. 1 & Trails at Aspen Ridge, Filing No. 2.

Approximately 82 acres of Waterview North lie in the upper reaches of the Marksheffel Tributary to Jimmy Camp Creek. This drainage basin was studied in the "Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives and Design of Selected Plan Report", by Kiowa Engineering, dated March 2015.

Approximately 16.2 acres of Waterview North lie in the upper reaches of the West Fork Tributary to Jimmy Camp Creek. This drainage basin was studied in the *"West Fork Jimmy Camp Creek Drainage Basin Planning Study"*, by Kiowa Engineering, dated October 2003, and in The FDRs for Trails at Aspen Ridge, Filing No.1 and Filing No.2.

Development of Waterview North will comply with the findings presented in each of the abovementioned Studies by providing onsite detention and water quality treatment for developed runoff. Offsite areas that lie upstream of Waterview North will be required to provide onsite detention and water quality treatment as they develop.

Design, phasing, responsibility and maintenance of proposed improvements will be discussed in future final drainage reports, at a later time. Fees will be assessed and paid according to current rates at the time of platting for each filing.

Sub-Basin Description

Historic Drainage Patterns

The historic drainage patterns of the site were analyzed in the Master Development Drainage Plan for Waterview by Merrick and Company. Offsite tributary areas are re-examined in this study. The offsite tributary to Waterview North lies to the north. A portion of the offsite tributary, approximately 63 acres, lies within the Big Johnson/Crews Gulch Basin Tributary. The remaining portion of the offsite watershed amounts to 56.7 acres, all of which lies within the Marksheffel Tributary to Jimmy Camp Creek. The reason that the offsite tributary was re-examined is because review of the existing topography along the north boundary of the site revealed a depression whose volume exceeds 35 acrefeet. Most of the Big Johnson/Crews Gulch offsite tributary area (54 out of 63 acres, area BJD-12a) appears to drain into this depression. Soils in this region are classified as Hydrologic Type A. The hydraulic conductivity for soils that coincide with the offsite tributary to Big Johnson/Crews Gulch Basin drains to an existing Box Culvert Crossing along Powers Blvd.

Onsite Basin JCDEX-3.3 consists of ten acres that coincide with the southwest corner of the property. JCDEX-3.3 runoff conveys to an existing dual 42-inch CMP crossing under Bradley Road where it discharges from the site and continues to convey south.

Runoff produced over the Marksheffel tributary to Jimmy Camp Creek accounts for the majority of onsite runoff generated. The portion of the Marksheffel Tributary considered with this analysis is represented by offsite Basins JCD OS-1A & JCD OS-1B, and by onsite Basins JCDEX-3.1 & JCDEX-3.2. Runoff generated over these basins conveys to the south and east and discharges from the site over the eastern boundary. Runoff produced on JCDEX-3.2 flows south and then east being conveyed

eastward in the north side Bradley Road ditch combined with Bradley Road runoff within the Bradley Road RIGHT-OF-WAY. JCDEX-3.2 runoff and Bradley Road runoff leaves the Bradley Road RIGHT-OF-WAY and flows north across the subject property as Bradley Road approaches the eastern property boundary; this is due to no continuation of the north Bradley Road ditch east of the property related to a utility corridor access running north south along the east side of the subject property. Bradley Road ditch flow including Basin JCDEX3.2 runoff then flows north and combines with Basin JCDEX3.1 runoff and discharges across the southern portion of the eastern boundary of the site at a low point in the utility access corridor. Flows generated over the other 3 basins discharge across the eastern site boundary as well. Topography along the eastern boundary does not seem to indicate the presence of concentrated flow patterns, although the southern portion of the eastern boundary bears a depression. Design Point JCD-D has been loosely placed to coincide with said depression. Please refer to the Pre-Development Drainage Map, included in Appendix B. The length of the low region along the eastern boundary is between 300 and 400 feet. About 30' beyond the depression due east, there lies an elevated mound of dirt (utility access). Above-ground power poles follow the eastern boundary. With the exception of the mentioned mound of dirt, the manner of fall in and around this area is generally to the east and south of east. Runoff will convey eastward, north of Bradley Road in somewhat of an unconcentrated manner, for 950 to 1000 feet. As runoff approaches the western side of Foreign Trade Boulevard, the depression in which the runoff conveys narrows to form a headwater pool for the culvert crossing at Foreign Trade Boulevard. Said culvert crossing consists four-48" Diameter RCPs.

Off-Site Drainage

There are two off-site basins for Waterview North. One of them is located in the Big Johnson/Crews Gulch Tributary and the other lies within the Marksheffel Tributary to Jimmy Camp Creek. These basins were analyzed in the MDDP for Waterview by Merrick. Flows generated over these areas have been re-calculated in this study with the discovery of the depression located within Basin BJD-12a.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

The El Paso County Drainage Criteria Manual (DCM), Volumes 1 & 2 were used in preparation of this report in conjunction with El Paso County's Engineering Criteria Manual (ECM) and Resolutions 15-042 and 19-245.

In addition to the DCM, Denver's Urban Storm Drainage Criteria Manuals, Volumes 1-3, published by the Urban Drainage and Flood Control District, latest update, have been used to supplement the DCM for water quality capture criteria.

Hydrologic Criteria

Rational Method

The rational method was used to calculate onsite peak flows, as required by the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM) for drainage basins having an area of less than 130 acres. The 5-year and 100-year storms constitute the major and minor events with these analyses, respectively.

Rational Method calculations are included in Appendix B, at the back of the report. Rational Method results are summarized and in tabular format on each of the respective drainage exhibits.

The results of the rational analysis are used to evaluate hydraulic street and channel capacities and to size storm drain appurtenances and components such as drop inlets/catch basins and pipe sizes. The Rational Method uses the following equation: Q=C*i*A

Where:

Q = Maximum runoff rate in cubic feet per second (cfs)

C = Runoff coefficient

i = Average rainfall intensity (inches per hour)

A = Area of drainage sub-basin (acres)

Runoff Coefficients

Rational Method runoff coefficients are referenced from Table 6-6 of the Drainage Criteria Manual. Pre-Development runoff coefficients are based on hydrologic soil type and vegetative cover type. Weighted runoff coefficients for existing or pre-development conditions are calculated for basins comprised by more than one hydrologic soil type. Weighted runoff coefficients for post development conditions are based on hydrologic soil type and anticipated land use. Weighted coefficient calculations are not performed for basins that consist of one hydrologic soil type, for which one type of land use is anticipated. Please refer to the Runoff Coefficient Exhibit, included in Appendix B. Summary tables for runoff coefficients during both pre and post development conditions are included as well as a map which shows the site with land-use and soil-type overlays. Percent Impervious for each basin during predevelopment conditions is assumed to be zero.

Land Use or Surface	Percent	Runoff Coefficients											
Characteristics	Impervious	2-year		5-y	ear	10-1	year	25-year		50-year		100-	year
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	<mark>95</mark>	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.12	0.23	0.20	0.31	0.32	0.40	0.37	0.48	0.35	0.52
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis													
Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when	45												
landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.00	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Percent Impervious values, runoff coefficients, and curve numbers for each basin during post development conditions are weighted according to the combination of hydrologic soil type and land use-type. There are proposed residential areas where the density exceeds 8 dwelling units per acre. Runoff coefficients for these areas are extrapolated from the values shown with Table 6-6.

Time of Concentration

Time of concentration values are calculated as required by the DCM. The time of concentration consists of the initial time of overland flow (Ti), characterized by Equation 6-8 from the DCM, and the travel time (Tt) for channel or street flow to the inlet or point of interest, characterized by Equation 6-9 from the DCM. Equation 6-9 includes a conveyance coefficient, Cv, whose value is chosen from Table 6-7 of the DCM. Table 6.7 is shown below:

Type of Land Surface	С,			
Heavy meadow	2.5			
Tillage/field	5			
Riprap (not buried)*	6.5			
Short pasture and lawns	7			
Nearly bare ground	10			
Grassed waterway	15			
Paved areas and shallow paved swales	20			
*For buried riprap, select C, value based on type of vegetative cover.				

Table 6-7. Conveyance Coefficient, C_v

Pre-Development Conveyance Coefficients are representative of short pasture and lawns. Post Development Conveyance Coefficients reflect grassed waterways, which coincide with the 90-foot zoning buffers proposed along the northern and eastern property boundaries, and paved areas or shallow paved swales which coincide with proposed onsite streets and parking.

The time of concentration (Tc) is equal to the sum of the initial and travel times (Equation 6-7 from the DCM). A minimum time of concentration of 10-minutes is used for modeling undeveloped conditions and for developed conditions in non-urban areas. A minimum Tc of 5 minutes is utilized during post development conditions for urban areas.

Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Drainage Criteria Manual. Table 6-2 lists the rainfall depth for the Major and Minor 1-hour storm events. The rainfall depths are translated into intensity values to be used with the rational formula by application of the IDF curves described on Figure 6-5 and shown, below. The referenced table and figures may be found in the front portion of Appendix B.

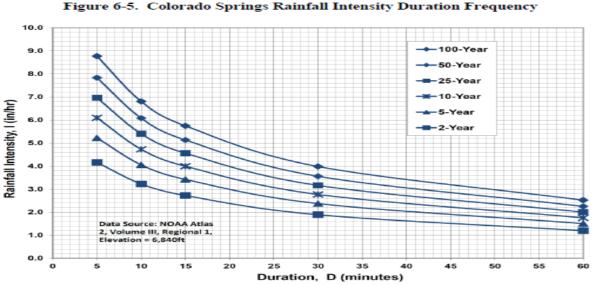


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency

Curves presented on Figure 6-5 are developed from the IDF Equations shown below:

IDF Equations $I_{100} = -2.52 \ln(D) + 12.735$ $I_{50} = -2.25 \ln(D) + 11.375$ $I_{25} = -2.00 \ln(D) + 10.111$ $I_{10} = -1.75 \ln(D) + 8.847$ $I_{5} = -1.50 \ln(D) + 7.583$ $I_{2} = -1.19 \ln(D) + 6.035$ Note: Values calculated by equations may not precisely duplicate values read from figure.

Culvert Design

There are two culverts that exist along this site's boundary from which onsite flows discharge. An existing 10' by 6' RCBC along Powers Blvd., and a dual 42-inch diameter CMP crossing under Bradley Road. Both culverts are analyzed during pre and post development conditions in this study. Placement of a proposed culvert along the north side of Bradley Road, adjacent to the eastern boundary of the site, is discussed and design calculations are included. Said calculations are located in Appendix D and were executed using HY-8. While the use of culverts is anticipated with future development of this property, there are no culverts proposed as part of this study.

Detention Storage Criteria

This report addresses the preliminary design of the detention / water quality ponds within the proposed development. Proposed ponds are designed as Full Spectrum. Pond hydraulics, treatment efficacy, and outlet structure performance are modelled with MHFD's software, MHFD-Detention_v4 02.

Storage volumes and outflows have been calculated for all detention facilities proposed herein. The proposed ponds serve to offsite peak developed flows adequately. The final design for each pond will be completed and submitted for approval with a subsequent Final Drainage Report, at a later time. The dimensions and performance of subsequent final pond designs are subject to change as long as code requirements are satisfied. Please note, while Pond A serves to treat developed runoff from proposed onsite commercial areas, the actual development for each of the commercially zoned lots will require that the developer be responsible for balancing and treating their own post development runoff. That is, each commercial lot will require its own pond.

HYDROLOGIC ANALYSES

Pre-Development Drainage Analysis

Big Johnson/Crews Gulch Basin & Jimmy Camp Creek Basins

Adjacent portions of the Big Johnson/Crews Gulch and Jimmy Camp Creek watersheds are presented on the Pre-Development Drainage Map, included in Appendix B.

Big Johnson/Crews Gulch Basin Tributary

The portion of the site that belongs to Big Johnson/Crews Gulch Tributary produces runoff that concentrates at Design Point BJD-K. There is also an offsite basin, BJD-12b that covers 9.54 acres and produces runoff that conveys to Design Point BJD-K. The peak flow rate that occurs at Design Point BJD-K during pre-development conditions is equal to 4 cfs and 31 cfs for the 5 and 100-year storms, respectively.

Offsite Basin BJD-12a runoff conveys into an existing 34+ acre-foot depression. The volume of the depression exceeds the volume of runoff for both 5 and 100-yr events. A basin calculation using the MHFD-Detention_v4 02 spreadsheet is included in Appendix C and shows the volume of runoff for the various events versus the volume of the existing offsite pond/depression. Runoff produced over Basin BJD-12a is not accepted onsite and does not impact Design Point BJD-K.

Runoff produced over Basin BJDEX14 conveys to the south and west, as sheet flow, over and across Powers Boulevard.

Jimmy Camp Basin

The historic basins for both tributaries of Jimmy Camp Creek are analyzed with the rational formula. Flows shown with the basin identifiers on the Drainage Exhibits reflect the results of said rational analysis. The Pre-Dev Drainage Basin Map and calculations are included in Appendix B for reference and are summarized below:

- Design Point A (Q₅=4cfs, Q₁₀₀=31cfs) is located on the north side of the adjacent western portion of Bradley Road. Design Pt. A receives runoff generated over Basin JCDEX-3.3. These flows convey south, across Bradley Road via an existing dual 42" CMP Culvert Crossing. Flows conveyed by the dual culvert crossing discharge into an existing swale on the south side of Bradley and continue to convey south. Design Point A is represented by Design Point 1-OS in the referenced FDR for Filing No. 1 of Trails at Aspen Ridge. Referenced peak flow rate values at Design Point 1-OS during pre-development conditions equal 5.0 cfs and 25.3cfs for the 5 & 100-year events, respectively. Flows discharged from Design Pt. A feed the West Fork Tributary to Jimmy Camp Creek.
- Design Point JCD-D has been placed to loosely coincide with a depression that occurs along the eastern boundary of the site. Said depression stretches 300 feet across, due north from the northern edge of Bradley Road, and is approximately 1-foot deep at its deepest point as measured along the eastern property boundary. A mound of dirt has been placed within said depression, by others, just beyond the eastern property boundary, as part of utility access from Bradley Road north for the existing power poles along the east boundary. Said mound of dirt serves to obscure historic flow patterns. Design Point JCD-D is the location where runoff from the north side of Bradley Road ROW, onsite Basins JCDEX-3.1 & JCDEX-3.2 and offsite Basins JCD-OS1A & JCD-OS1B combine and convey east to feed the Marksheffel Tributary to Jimmy Camp Creek. Major and minor flows at Design Point JCD-D are equal to 84cfs & 12cfs, respectively.

Post Development Drainage Analysis

Big Johnson/Crews Gulch Basin

Onsite runoff generated over areas that belong to the Big Johnson/Crews Gulch Basin Tributary are captured and conveyed into Pond BJD-K, with the exception of onsite Basin BJDEV-14.

The portion of the site that covers the western boundary of Waterview North, characterized as Basin BJDEV14 on the Post Development Drainage Plan, presently drains to the west over and across Powers Boulevard and ultimately into Big Johnson/Crews Gulch Basin. CDOT construction of Powers Boule vard type overnements with regard in a hydraulic barrier to sanface remoting enerated over Basin BJD-EX14, as it presently conveys. Post Development conditions refer to the subject area as Basin BJDEV-14. While runoff generated over Basin BJDEV14 will not continue to convey in historic fashion, as surface flow that crosses Powers Blvd., it is assumed that construction of the Powers Improvements will see the historic drainage pattern maintained in some form or fashion, and Basin BJDEV14 runoff will continue to convey to Big Johnson/Crews Gulch Basin. Developed Flows from BJDEV-14 will be treated prior to being discharged at or below the historic peak rate. For the post development analysis included herein, Basin BJD-EX14 (undeveloped) runoff is routed across Basin JCD-DEV3.3 and into proposed Pond A. Post development discharge from Pond A was calculated to be 1 cfs & 17 cfs for the minor and major events, respectively. Post Development rates of discharge from Pond A do not exceed Historic rates, so the proposed pond is in conformance.

Pond BJD-K

Flows generated over onsite Basin BJD-12c convex into Pond BJD-K. Pond BJD-K is located about 70 feet to the Clarify. The developed drainage map is showing this basin is routed olume and serves t into Pond A. Update Pond A calculation to include basin BJDEV-14 for st entirely abd the pond sizing. Pond les full

BJD-K serv

spectrum tre However, if basin BJDEV-14 is supposed to have it's own wq/detention BJD-K and then show the pond on the proposed drainage map and provide the Powers Boy pond calculation. Assuming discharge is as shown on the proposed that peak fle map then Pond A must be redesigned as a pond in a series.

The pre-developed rate of discharge from the site at Design Point BJD-K was determined to be 4 and 31cfs for the 5 and 100-year events. The post development peak rate of discharge at the same location is 1 and 9 cfs for the 5 and 100-year events, respectively. In the Amendment to the MDDP for Waterview, completed by Springs Engineering and approved in July of 2014, post development flows at the same location were shown to be 239cfs and 215cfs for the major and minor storms, respectively. The depression shown to the north of the Waterview North site on the pre & post development Drainage Exhibits is not accounted for in the referenced analysis.

Suitable Outfall

The existing 10' by 6' RCBC Crossing under Powers Blvd. feeds a man-made channel that conveys south to the location of an anticipated culvert crossing under future Bradley Road improvements, then further south into Big Johnson Reservoir. The channel is shown on Sheet 4, Proposed Drainage Map for Waterview II, from the Amendment to Waterview MDDP, produced by Springs Engineering on 7/21/2014 and approved on 8/28/2014. Flows at the existing RCBC Crossing under Powers Blvd are shown to be 109.8 cfs and 170.9 cfs for the 10 & 100-year events, respectively. Post Development discharge at Design Point BJD-K, as presented with the findings contained

ond

under

sins so

herein, amount to 1 & 9 cfs for the 5 & 100-year events, respectively. The channel improvements, as they exist, are more than adequate to accommodate outfall from the Waterview North site.

Jimmy Camp Creek Basin

There are 2 onsite and 2 offsite drainage basins located within the Marksheffel Tributary to Jimmy Camp Creek.

Offsite Basins JCDOS-1A & JCDOS-1B account for 56.7 acres of undeveloped offsite tributary. Runoff generated from these basins is accepted onsite. Runoff from these two basins is accommodated for during post development conditions by an onsite, grass lined diversion channel. Said channel is proposed within a 90-foot wide landscape buffer that follows the northern and eastern boundaries of the site. The subject diversion channel's width will exceed 30-feet, so it will be constructed with access ways on both sides so as to satisfy requirements set forth by ECM Section 3.3.3.K.1. The diversion channel shall be free of fencing and proposed structures and will not be used to store construction materials. Flows conveyed within the proposed channel will convey east, along the northern boundary, then south, adjacent to the eastern boundary of the site. Flows conveyed within this channel will combine with discharge from Pond JCD-D before discharging across the eastern boundary. Possible conveyance to the east is discussed as part of suitable outfall for Pond JCD-D below.

<u>Onsite developed flows</u> will convey to Pond JCD-D where runoff will be treated, and peak flows attenuated to at or below historic levels prior to discharging from the pond. Pond JCD-D is situated along the eastern boundary of the site. Onsite runoff is generated over 2 basins; JCDEV-3.1 & JCDEV-3.2. Runoff from JCDEV-3.2 will convey south and east to Pond JCD-D; site grading will modify existing conditions and will not allow flow from this basin to enter Bradley Road ROW. Discharge into Pond JCD-D will either be by way of a culvert crossing under the entrance to the site, or through future storm drain improvements for the area. Runoff produced over area JCDEV-3.1 will convey to Pond JCD-D as a combination of surface flows and storm drain discharge. Basins JCDEV-3.1 & JCDEV-3.2 account for approximately 82 acres of onsite development.

Pond JCD-D

Pond JCD-D has a volume of 11.25 Acre-Feet and is designed to provide Full Spectrum Treatment to onsite developed runoff. The Water Quality Capture Volume (WQCV) for the pond is 2.317 Acre-Ft and the Excess Urban Runoff Volume (EURV) is 7.441 Acre-Ft. Pond JCD-D is approximately 8.0 feet deep on the high side of the containment berm. The peak outflow from Pond JCD-D, given a 100-yr event, is equal to 101 cfs. Discharge from Pond JCD-D combine with offsite flows from basins JCDOS-1A & JCDOS-1B prior to discharging east.

Suitable Outfall

Flows that discharge from Pond JCD-D combine with the offsite flows in the eastside diversion channel along with the northerly roadside ditch of Bradley Road; the Bradley Road ditch flow is blocked from following Bradley Road east and leaves the right-of-way and flows north onto the subject property as described in the historic conditions section of this report. Runoff that is tributary to this confluence, offsite flows from the diversion channel, discharge from Pond JCD-D and Bradley Road ditch flow must discharge from the site to the east.

There are two primary feasible options. Both options assume the confluence of Pond JCD-D discharge, the east side diversion channel and the northerly roadside ditch for Bradley Road:

Add bullet point

• Unconcentrated Discharge: The diversion channel, the pond discharge and flow from Bradley Road right-of-way would naturally follow the existing flow to the east through an existing depression where ponding would occur until flow is deep enough to continue east. Control of this discharge could be enhanced with a flow spreader consisting of a weir approximately 300-feet long matching the existing depression width. Flow over this weir is estimated to be about 4-inches deep under 100-year conditions. Erosion protection could be added upstream and downstream of the weir. This option allows flows to follow existing flow patterns to the east; however, it does not address the issue that Bradley Road runoff does not stay within Bradley Road.

Concentrated Discharge: Concentrated discharge to a public right-of-way could be accomplished by correcting the Bradley Road ditch issue east of the property by installing a culvert through the existing berm. Preliminary sizing indicates the culvert would be 48-inches and approximately 100-feet long. This correction would Bradley Road right-of-way runoff to stay in the right-ofway and would allow discharge of Pond JCD right-of-way. Any long-term detrimental eff and to areas further to the east from the site c significantly reduced. Errant and erratic flow unconcentrated fashion, or as sheet flow, cou

options are currently being considered within

JCDEV3.3. Recommend separating the two

Pond A

Detention Pond K, shown on the post developme options into two bullet points similar to the of the western portion of Bradley Road, serves to above outfall alternative for pond D. commercially zoned portion of the site. Please no commercially zoned areas will be lot specific. The For each option clearly identify the responsible for treating and balancing their own wg/detention for basin BJDEV14 since this proposed Pond A or from each of the proposed c basin is being routed through Pond A. Design Point A. Design Point A marks the location of an existing dual 42-men diameter eith crossing under Bradley Road. This culvert crossing was analyzed in the FDR for Filing 1of The Trails at Aspen Ridge. Design Point A in the Pre-Development Analysis included with this study coincides with Design Point 1-OS from the referenced Study. Table 7.7a from page 12 of the abovementioned FDR indicates major and minor peak flow rates of 4 and 27 cfs, respectively, at Design Point OS-1, or Design Point A. Given this existing crossings' proximity to a proposed entrance to the site, the high side of the culvert crossing will likely be appended with a junction structure. The outlet pipe from Pond A will terminate into said junction structure where flows will convey south to the low side of the culvert crossing. Per the Filing 1 Final Drainage Report for Trails at Aspen Ridge, a 24-inch RCP storm pipe will be sleeved into one of the existing 42-inch CMP cross road pipes to minimize disturbance to Bradley Road and avoid conflicts with existing utilities. The second 42-inch diameter CMP at this location will be plugged. Onsite peak discharge rates from the site at Design Point A amount to 1 & 17 cfs for the minor and major events, respectively.

Suitable Outfall

Pond A will discharge from the site through a 24" RCP pipe that is sleeved through one of the dual 42-inch diameter CMPs that crosses under Bradley Road as referenced from the FDR for Trails at Aspen Ridge, Filing No. 1. The calculated discharge at Design Point A is less than the reference values from which the downstream improvements were designed. Design Point A continues to provide a suitable outfall for developed runoff from this project site.

The following is a table that summarizes some of the properties of each of the proposed ponds:

WATERVIEW NORTH POND SUMMARY TABLE

	C	Λ	L	H	HL	OIS P P	R H	CE AT R		PEAK	FLOW	S
POND ID	WQVC	EURV	TOTAL VOL.	MAX DEPTF	LENGTH TO WIDTH	POND DIMENSIO NS OF MAIN	100-YR DEPTH	SURFACE AREA AT 100-YR	Q(5)i n	Q(100)i n	Q(5)ou t	Q(100)ou t
	(Ac- Ft)	(Ac- Ft)	(Ac- Ft)	(Ft)		(Ft. x Ft.)	(Ac- Ft)	(Ac.)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)
POND A	0.347	1.029	1.517	7.0	2. 5	165 x 94	5.920	0.32 0	38	84	1	17
POND BJD- K	0.50	1.67	2.51	6.5	2. 0	210 x 125	5.17	0.54	37	74	1	9
POND JCD- D	2.32	7.44	11.25	8.0	2. 0	403 x 229	7.53	2.08	164	320	14	101

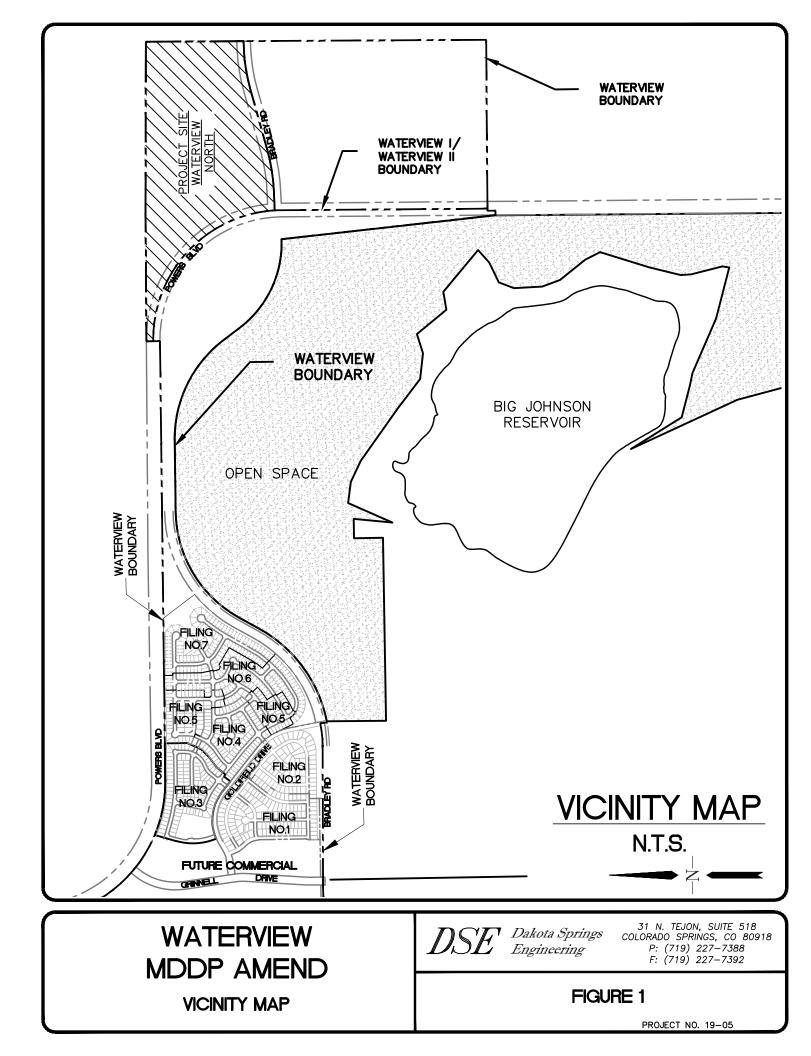
As commercial, industrial and residential development begins in this area, storm drain improvements will be implemented and drainage systems designed. Each Phase of residential and/or commercial development will require site-specific Preliminary and/or Final Drainage Studies to ensure that new developments do not increase peak rates of discharge or result in adverse effect to surrounding, upstream or downstream properties or facilities. Development of each commercial lot will also require a preliminary and or final drainage study as each lot will be required to balance its developed runoff.

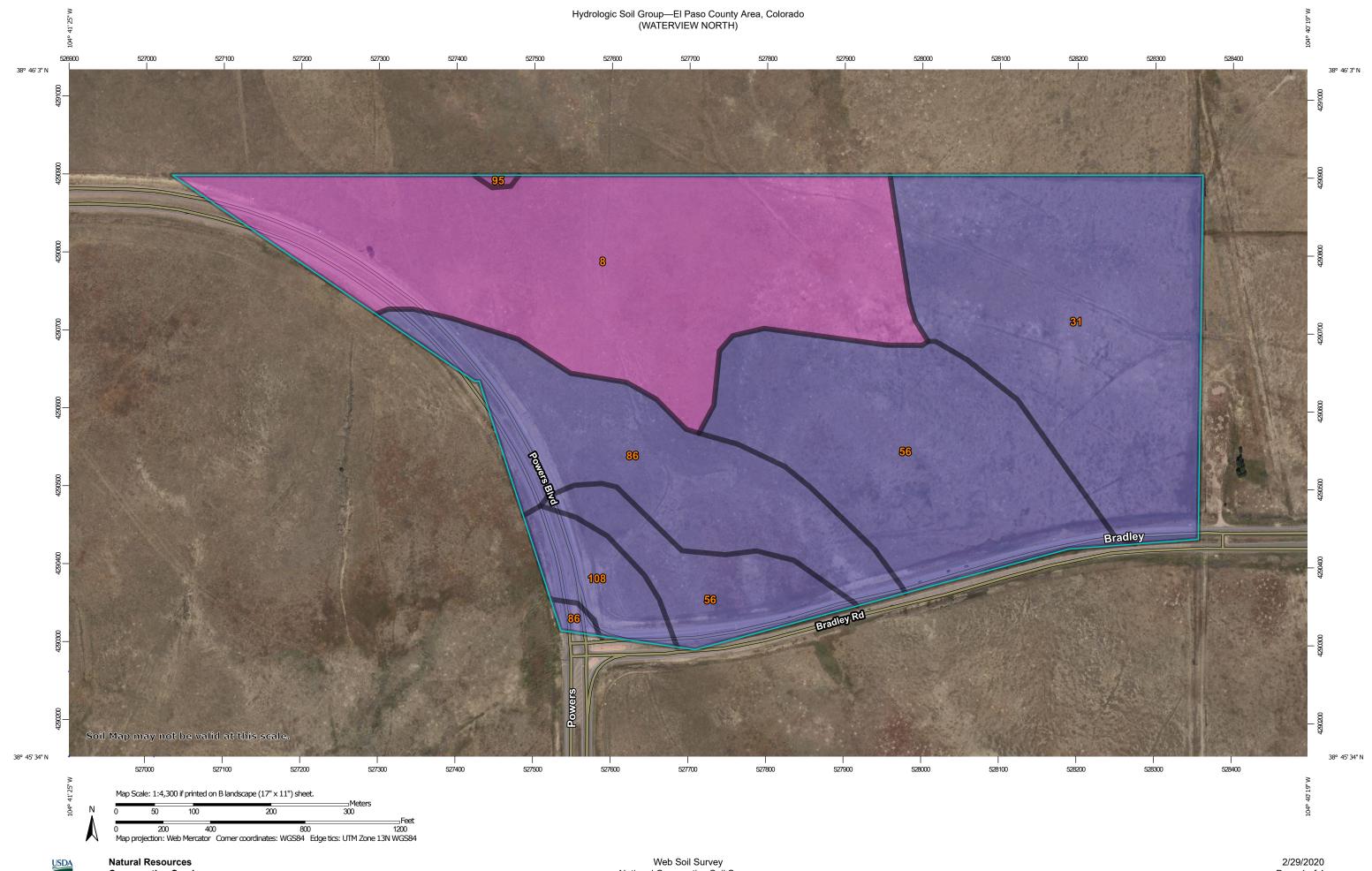
REFERENCE MATERIALS

- 1. "City of Colorado Springs/El Paso County Drainage Criteria Manual" September 1987, Revised November 1991, Revised October 1994.
- 2. "City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices" November 1, 2002.
- 3. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.
- 4. "Master Development Drainage Plan for Waterview", by Merrick & Co., May 2006
- 5. "Big Johnson/Crews Gulch Basin/Crews Gulch Drainage Basin Planning Study", Kiowa Engineering Corporation, September 1991.
- 6. *"Final Drainage Report for Trails at Aspen Ridge, Filing No. 1*" by The Matrix Design Group, January, 2020.
- 7. *"Final Drainage Report for Trails at Aspen Ridge, Filing No. 2*" by The Matrix Design Group, February, 2020.
- 8. "Amendment to the MDDP for Waterview" by Springs Engineering, July, 2014.

APPENDIX A

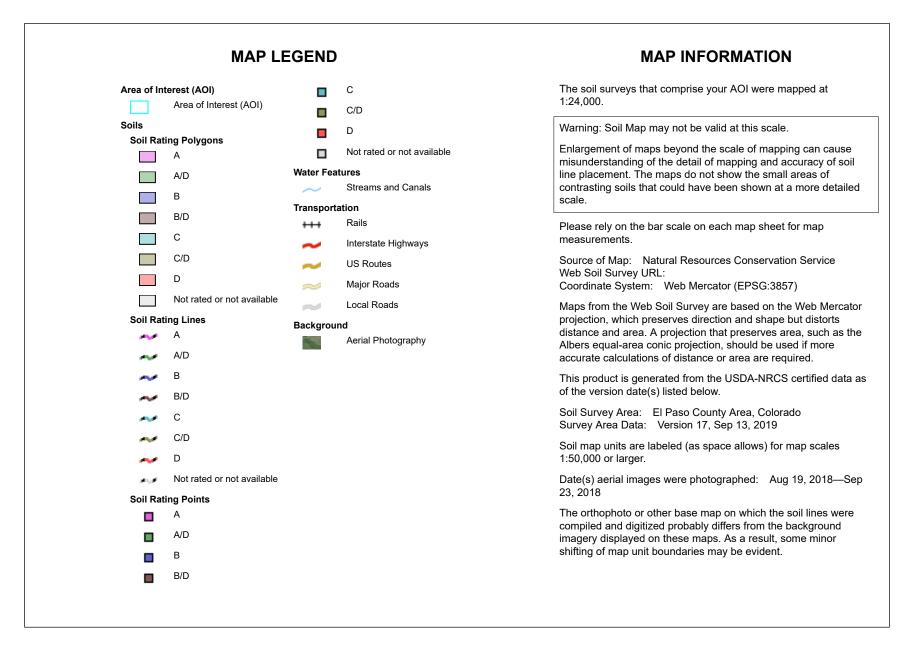
VICINITY MAP SOILS MAP ANNOTATED FIRMette





Natural Resources **Conservation Service**

Web Soil Survey National Cooperative Soil Survey



Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	43.7	32.5%
31	Fort Collins loam, 3 to 8 percent slopes	В	33.2	24.7%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	В	33.4	24.8%
86	Stoneham sandy loam, 3 to 8 percent slopes	В	19.8	14.7%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.2	0.1%
108	Wiley silt loam, 3 to 9 percent slopes	В	4.4	3.3%
Totals for Area of Inter	rest		134.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

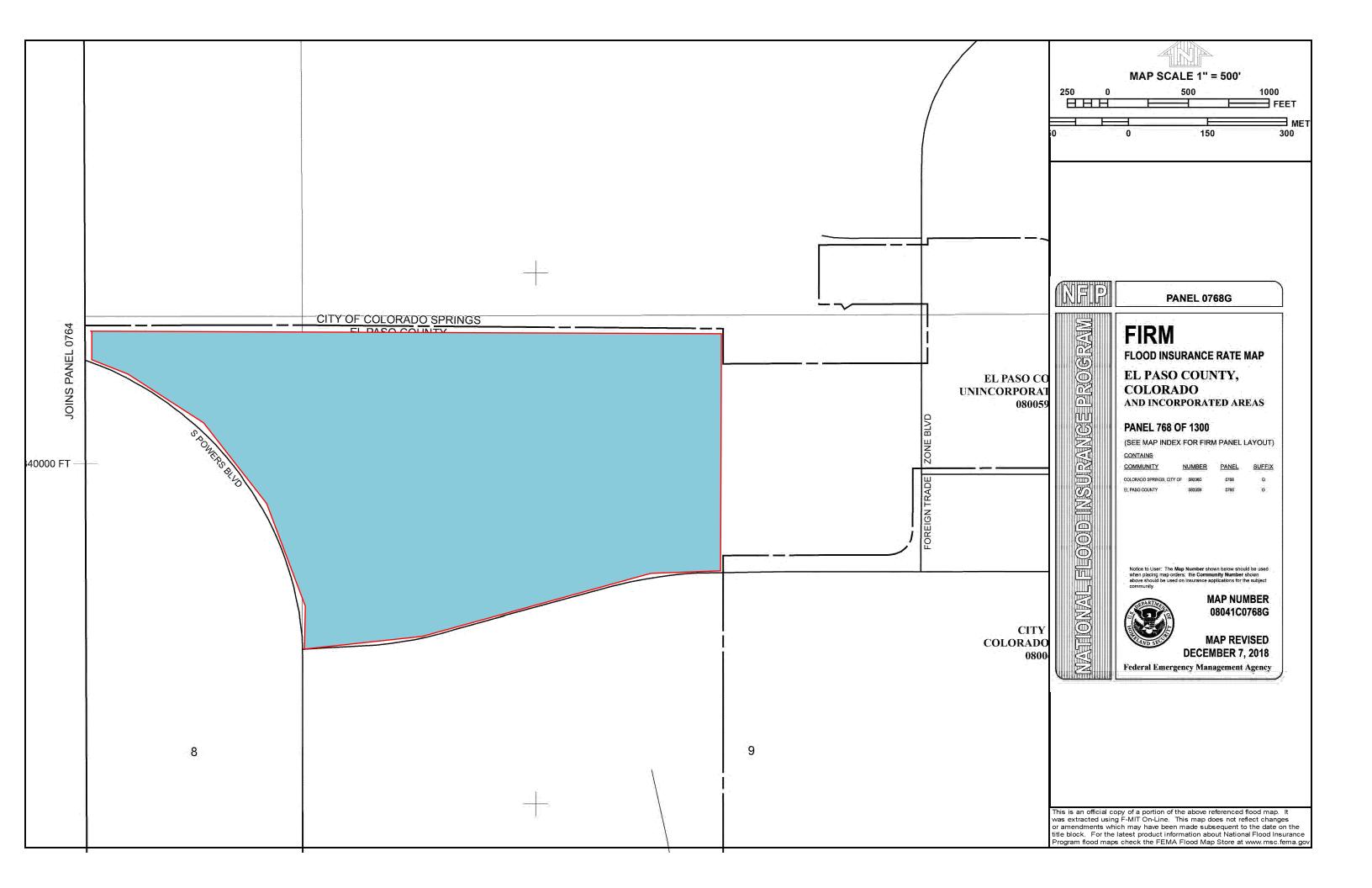
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition Component Percent Cutoff: None Specified Tie-break Rule: Higher



APPENDIX B

PRE & POST DEVELOPMENT RATIONAL ANALYSES PRE-DEVELOPMENT BASIN MAP POST DEVELOPMENT DRAINAGE PLAN

EL PASO COUNTY REFERENCE INFO RATIONAL ANALYSIS

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	.2.52	3.50	4.60

 Table 6-2. Rainfall Depths for Colorado Springs

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves² and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

• **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

Land Use or Surface	Percent					······	Runoff Co	efficients					
Characteristics	Impervious	2-y	ear	5-y	ear	10-	/ear	25-	/ear	50-1	year	100-	year
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0,49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential	wse KA		F	Ach	 						r	1.18	
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0,35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.03	0.03	0.12	0.13	0.20	0.25	0.30	0.40	0.34	0.40	0.33	0.52
Railroad Yard Areas	40	0.23	0.15	0.30	0.25	0.24	0.42	0.32	0.50	0.37	0.48	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.03	0.04	0.08	0.15	0.17	0.25	0.25	0.30	0.30	0.45	0.35	0.51
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0,31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
A ta ta													
Streets	400												
Paved Gravel	100 80	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0,94	0.95	0.95	0.96	0.96
טומעכו	<u>ە</u> 00	0.57	0.00	0.59	0.65	0.63	0.00	0.66	0.70	0.08	0.72	0,70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Table 6-6. Runoff Coefficients for Rational Method (Source: UDFCD 2001)

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_i) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For nonurban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_i) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Type of Land Surface	C_{ν}	
Heavy meadow	2.5	
Tillage/field	5	
Riprap (not buried) [*]	6.5	Ex. Good i
Short pasture and lawns	7	EX. V
Nearly bare ground	10	
Grassed waterway	15	- Er.
Paved areas and shallow paved swales	20	

Table 6-7.	Conveyance	Coefficient,	C_{ν}
------------	------------	--------------	-----------

For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_i) is then the sum of the overland flow time (t_i) and the travel time (t_i) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \tag{Eq. 6-10}$$

Where:

 t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

Minimum Time of Concentration 3.2.4

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

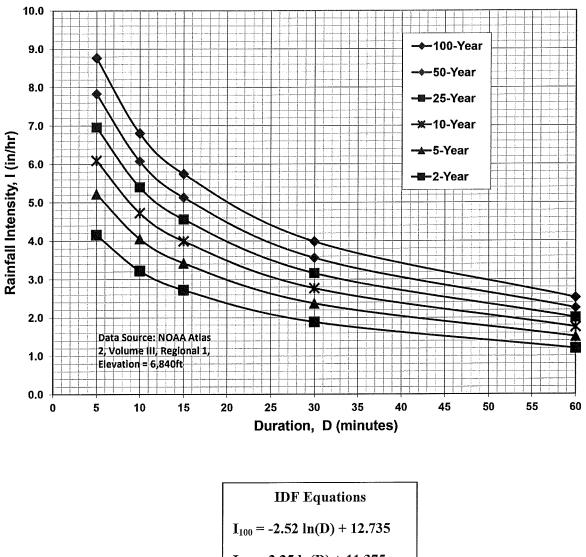


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency

IDF Equations							
$I_{100} = -2.52 \ln(D) + 12.735$							
$I_{50} = -2.25 \ln(D) + 11.375$							
I ₂₅ = -2.00 ln(D) + 10.111							
$I_{10} = -1.75 \ln(D) + 8.847$							
$I_5 = -1.50 \ln(D) + 7.583$							
$I_2 = -1.19 \ln(D) + 6.035$							
Note: Values calculated by equations may not precisely duplicate values read from figure.							

PRE-DEVELOPMENT RATIONAL ANALYSIS SUMMARY

WATERVIEW NORTH - EXISTING

(RATIONAL METHOD Q=CIA)

	T	OTAL	FLOW	S	AREA	WEIG	HTED		O V E	RLANI	D			СНА	NNEL			Tc TOTAL	INTE	NSITY	
BASIN	Q(5)	Q(100)	CA(ec	quiv.)	TOTAL	C(5)	C(100)	C(5)	Length	Slope	Ti	Length	Slope	Description	Convey	Velocity	Tt	IC IOTAL	I(5)	I(100)	COMMENTS
	(c.f.s.)	(c.f.s.)	5 YR	100 YR	(Ac)				(ft)	(ft)	(min)	(ft)	(%)	Code	Factor (K)	(fps)	(min)	(min)	(in/hr)	(in/hr)	
BJD-12a	8.3	60.6	4.34	19.00	54.28	0.08	0.35	0.08	300	3.7%	21.5	1,784	3.5%	3	7	1.3	22.7	44.2	1.9	3.2	
BJD-12b	2.0	14.8	0.76	3.34	9.54	0.08	0.35	0.08	295	2.8%	23.3	377	6.2%	3	7	1.7	3.6	26.9	2.6	4.4	
BJD-12c	2.8	20.5	1.46	6.38	18.23	0.08	0.35	0.08	300	3.3%	22.3	1,104	1.5%	3	7	0.9	21.5	43.7	1.9	3.2	
BJDEX-14	1.9	13.7	0.49	2.16	6.16	0.08	0.35	0.08	112	9.8%	9.5	377	9.1%	3	7	2.1	3.0	12.5	3.8	6.4	
JCD-OS1A	5.2	38.1	2.88	12.60	36.00	0.08	0.35	0.08	247	4.0%	19.0	2,545	4.6%	3	7	1.5	28.3	47.2	1.8	3.0	
JCD-OS1B	4.6	33.6	1.66	7.25	20.70	0.08	0.35	0.08	200	8.5%	13.3	1,167	5.8%	3	7	1.7	11.5	24.8	2.8	4.6	
JCD-EX3.1	9.4	69.1	5.49	24.01	68.60	0.08	0.35	0.08	300	8.3%	16.4	2,633	3.5%	3	7	1.3	33.5	49.9	1.7	2.9	
JCD-EX3.2	3.0	22.2	1.06	4.62	13.21	0.08	0.35	0.08	244	9.0%	14.4	958	6.6%	3	7	1.8	8.9	23.3	2.9	4.8	
JCD-EX3	2.6	19.1	0.80	3.50	10.00	0.08	0.35	0.08	297	11.8%	14.6	398	7.5%	3	7	1.9	3.5	18.0	3.2	5.4	
Design Points															_						
Α	4.2	30.8	1.29	5.66	16.16	0.08	0.35	0.08	297	11.8%	14.6	398	7.5%	3	7	1.9	3.5	18.0	3.2	5.4	Basin JCD-EX.3.3
		14.0	0.76	2.24	0.54	0.00	0.25	0.00	205	2.00/	00.0	077	6.00/	2	7	1.7	2.6	26.0	26	4.4	
BJD-12b	2.0	14.8	0.76	3.34	9.54	0.08	0.35	0.08	295	2.8%	23.3	377	6.2%	3	/	1.7	3.6	26.9	2.6	4.4	
BJD-12c	2.8	20.5	1.46	6.38	18.23 27.77	0.08	0.35	0.08	300	3.3%	22.3	1,104	1.5%	3	7	0.9	21.5	43.7	1.9	3.2	Desire DID 12h & DID 12a
BJD-K	4.3	31.2	2.22	9.72	21.11	0.08	0.35	0.08	300	3.3%	22.3	1,104	1.5%	3	/	0.9	21.5	43.7	1.9	3.2	Basins BJD-12b & BJD-12c
		7()	10.02	12.96	125.20	0.09	0.25	0.09	247	4.00/	10.0	4 001	2.90/	3	7	1.4	50 (79.6	1.0	17	ICD D WITHOUT ICD EV2.2
JCD-D	/10.4	76.2 69.1	10.02 5.49	43.86	125.30 68.60	0.08	0.35	0.08	247 300	4.0%	19.0 16.4	4,881 2,633	3.8%	3	7	1.4 1.3	59.6 33.5	78.6 49.9	1.0 1.7	2.9	JCD-D WITHOUT JCD-EX3.2
JOD-EX3.1	3.0	22.2	1.06	4.62	13.21	0.08	0.35	0.08	244	9.0%	10.4	2,035 958	<u>5.5%</u> 6.6%	3	7	1.3	8.9	23.3	2.9	4.8	
J¢D-EX3.2 J¢D-OS1.A	5.2	38.1	2.88	12.60	36.00	0.08	0.35	0.08	244	9.0%	14.4	2,545	4.6%	3	7	1.8	28.3	47.2	1.8	4.8	
ICD-OS1.A	4.6	33.6	1.66	7.25	20.70	0.08	0.35	0.08	247	4.0% 8.5%	13.3	1,167	5.8%	3	7	1.3	11.5	24.8	2.8		BASINS JCD-EX3.1, JCD-EX3.2,
JCD-0SI.B	11.5	84.2	11.08	48.48	138.51	0.08	0.35	0.08	200	4.0%	19.0	4,881	3.8%	3	7	1.7	59.6	78.6	1.0	4.0	JCD-OS1.A, & JCD-OS1.B
JUD	11.5	04.2	11.00	+0.+0	150.51	0.08	0.55	0.08	24/	4.070	17.0	4,001	5.070	5	1	1.4	57.0	70.0	1.0	1./	JCD-051.A, & JCD-051.D
																		ID	F Equation	15	
						1			0.205 (11 - 0								$I_{100} = -2.5$	$2\ln(D) + 1$	2.735	

U	FCI Tab	ble 6-2 NRCS Conveyance Factors, K	
	Cøde	Description	K
	/1	Heavy meadow	2.5
[2	Tillage/field	5
	3	Short pasture and lawns	7
	4	Nearly bare ground	10
7	5	Grassed waterway	15
Γ	6	Paved areas and shallow paved swales	20

$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$
$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$
Computed $t_c = t_i + t_t$

Only basin JCD-EX3.3 is tributary to Design Point A based on the narrative that BJDEX-14 presently flows over Powers Blvd; therefore total flows at design point A should match JCD-EX3.

Update the values on the narrative (pg 14). What should be stated in the narrative is that your calculated (2.6/19.1cfs) are less than what's calculated in Trails FDR (5.0/25.3 cfs); therefore, this verifies the Trails drainage system provides adequate capacity to route flows from basin JCD-EX3.3.

Similar type of statement should be noted in the developed condition to clearly verify the receiving off-site system has adequate capacity.

However, if DPA values (4.2/30.8) is based on diversion of BJDEX-14 to DP A due to future CDOT construction of Powers Blvd then update the comments section for DPA in this worksheet. Also provide a statement regarding this development's conformance with the receiving offsite system designed/constructed by Trails FDR.

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IDF Equations
$I_{100} = -2.52 \ln(D) + 12.735$
$I_{50} = -2.25 \ln(D) + 11.375$

 $I_{25} = -2.00 \ln(D) + 10.111$

 $I_{10} = -1.75 \ln(D) + 8.847$

 $I_5 = -1.50 \ln(D) + 7.583$

 $I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

PRE-DEVELOPMENT WEIGHTED CURVE NUMBER & RUNOFF COEFFICIENT CALCULATIONS

Waterview North

BASIN	Total	HSG		WEIGH	TED RESULTANT	VALUES	ca-equiv	alent	Initial
ID	Area (Ac.)	A/B	% IMPERV	CN	C5	C100	CA ₅	CA100	Abstraction(Ia)
BJD-12a	54.28	А	0.0						
DOD 120	04.20	~	0.0	28.0	0.08	0.35	4.3424	19.00	2.571428571
BJD-12b	9.54	А	0.0						
				28.0	0.08	0.35	0.7632	3.34	2.571428571
BJD-12c	18.23	A/B	0.0		0.00	0.05	4 4504	(00	1 170010010
				46	0.08	0.35	1.4584	6.38	1.173913043
BJDEX-14	6.16	В	0.0	14.0	0.00	0.05	0.4000	0.17	1 170010040
				46.0	0.08	0.35	0.4928	2.16	1.173913043
JCD-OS1A	36.00	А	0.0	20.0	0.00	0.05	2.00	10 (0	0.571400571
				28.0	0.08	0.35	2.88	12.60	2.571428571
JCD-OS1B	20.70	A/B	0.0	34.3	0.00	0.25	1 / 5 /	7.05	
				34.3	0.08	0.35	1.656	7.25	<u>1.915451895</u>
JCDEX-3.1	68.60	A/B	0.0	40.6	0.08	0.35	5.488	24.01	1.463054187
				40.0	0.00	0.30	0.400	24.01	1.403034107
JCDEX-3.2	13.21	В	0.0	46.0	0.08	0.35	1.0568	4.62	1.173913043
				40.0	0.00	0.30	1.0000	4.02	1.1/3713043
JCDEX-3.3	10.00	В	0.0	46.0	0.08	0.35	0.8	3.50	1.173913043
				40.0	0.00	0.55	0.0	3.00	1.1/3713043

Note: Antecedent Runoff Condition = 1, Runoff Coefficients refered from Table 6-6, CNs referenced from Table 6-9 of the DCM.

Land Use	% Imp.	5-yr (C)	100-yr (C)	CN	CN
ID		HSG A & B	HSG A & B	HSG A	HSG B
*Brush/Weed/Grass	0	0.08	0.35	28	46
INDUSTRIAL	80	0.59	0.7	81	88
COMMERCIAL	95	0.81	0.88	89	92
**RESIDENTIAL	80	0.6	0.68	82	90

* Offsite Basin land use is Pasture/Meadow For the Rational Analysis and Brush- brush weed grass for the UH Analysis - unless noted otherwise.

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Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/14/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 ,-Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJD-12a 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation **Overland Flow** Reach Length L_i (ft) Slope (ft) (ft) ID S_i (ft/ft) (Optional) (Optional)

			(Optional)	(Optional)	
C		300.00	6054.00	6043.00	0.037
Total Overla	nd Length (ft)	300.00	Length-We	eighted Slope (ft/ft)	0.037

CHANNELIZED FLOW

	Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
	SC1	789.00	6043.00	6003.00	0.051
	SC2	995.00	6003.00	5981.00	0.022
Total Char	tal Channelized Length (ft) 1784.00		Length-We	0.035	

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Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/14/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJD-12b 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VENEAU 6010.00 6018.30 0.028 295.00 295.00 Length-Weighted Slope (ft/ft) 0.028 Total Overland Length (ft) CHANNELIZED FLOW

	Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
	SC1	355.00	6010.00	5988.00	0.062
Total Char	nnelized Length (ft)	355.00	Length-We	eighted Slope (ft/ft)	0.062

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/14/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJD-12c 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) L_i (ft) (Optional) (Optional) NIAN 6000.00 5990.25 0.033 300.00

		500.00	0000.00	0330.20	0.000
Total O	verland Length (ft)	300.00	Length-We	eighted Slope (ft/ft)	0.033
			-		

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	656.00	5990.25	5975.90	0.022
SC2	448.00	5975.90	5973.75	0.005
Total Channelized Longth (ft)	4404.00	Leweth M	aimhtad Clama (ft/ft)	0.045
Total Channelized Length (ft)	1104.00	Length-W	eighted Slope (ft/ft)	0.015

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/14/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJDEX-14 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID (Optional) S_i (ft/ft) L_i (ft) (Optional) VENEAN 0.098 112.00 Length-Weighted Slope (ft/ft) 0.098 Total Overland Length (ft) 112.00 CHANNELIZED FLOW Channelized Flow Channelized Flow U/S Elevation **D/S Elevation** Reach I ongth /f+) /f+) Slone

	ID	Length L _t (ft)	(ft) (Optional)	(ft) (Optional)	Slope S _t (ft/ft)
	SC1	377.00			0.091
Char	nnelized Length (ft)	377.00	Length-We	ighted Slope (ft/ft)	0.091

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-BJDEX-14 Weighted Slope

Total

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/14/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) JCD-EX3.1 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VENEAN 5971.00 300.00 5996.00 0.083

0.083

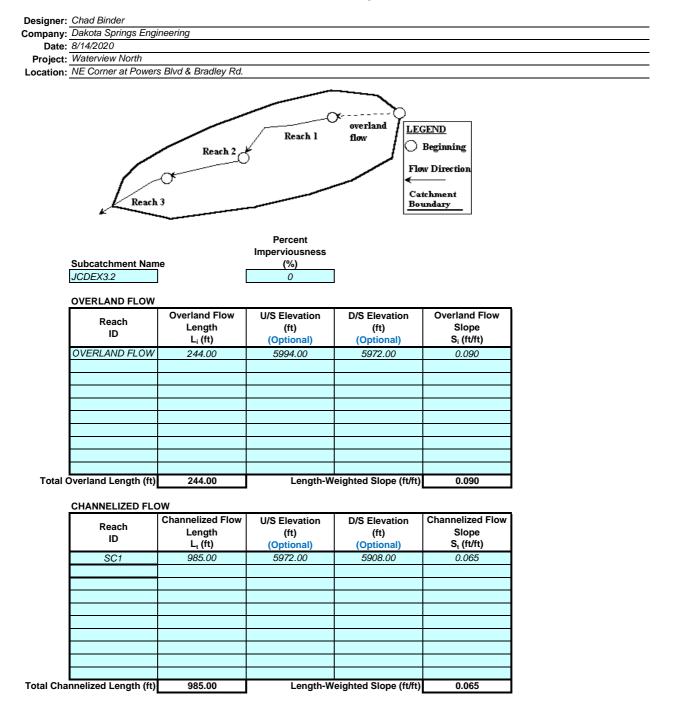
Total Overland Length (ft) 300.00 Length-Weighted Slope (ft/ft)

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	899.00	5971.50	5930.50	0.046
SC2	1734.00	5930.50	5880.00	0.029
tal Channelized Length (ft)	2633.00	Length-W	eighted Slope (ft/ft)	0.035

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCDEV3.1 Weighted Slope

Version 2.00 released May 2017



Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/21/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) JCD OS-1B 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VENEAN 6000.00 6013.50 0.068 200.00

Length-Weighted Slope (ft/ft)

0.068

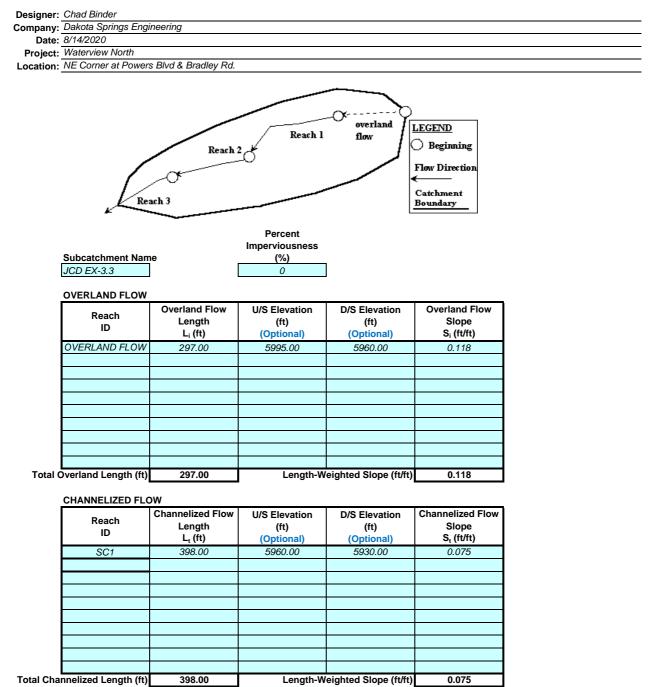
Total Overland Length (ft) 200.00

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	1167.00	6000.00	5932.00	0.058
al Channelized Length (ft)	1167.00	Length-W	eighted Slope (ft/ft)	0.058

EXISTING COND'N-COMPOSITE CALCS.xlsm, Sub-JCD OS-1B Weighted Slope

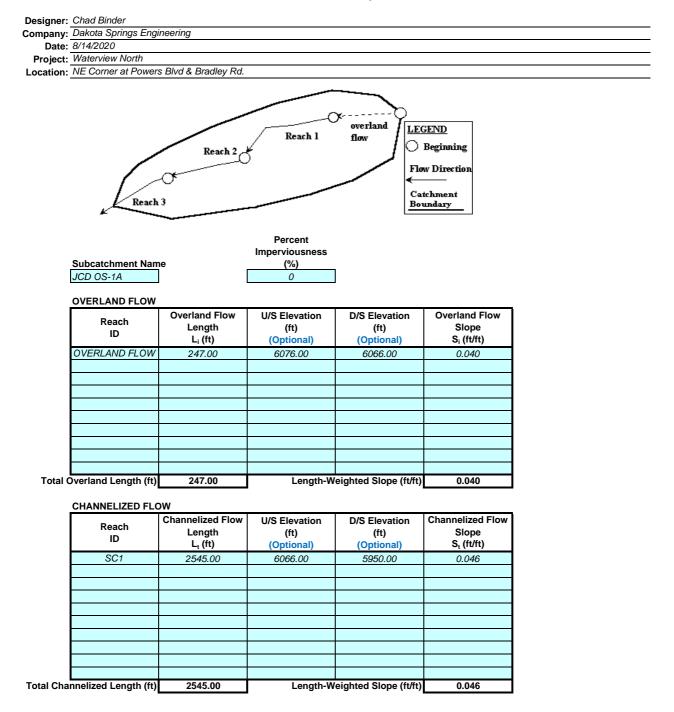
Version 2.00 released May 2017



398.00 Total Channelized Length (ft)

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCDEV3.3 Weighted Slope

Version 2.00 released May 2017



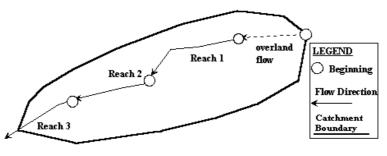
PRE DEVELOPMENT RATIONAL ANALYSIS WEIGHTED Tc CALCS

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name BJD-12a

OVERLAND FLOW

OVERLAND FLOW			_	
Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	300.00	0.037	0.08	20.71
Weighted Totals	300.00	0.037	Total t _i (min)	20.71

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	789.00	0.051	7	8.32
SC-2	995.00	0.022	7	15.97
Weighted Totals	1784.00	0.035	Total t _t (min)	24.29

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	43.70

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-BJD-12a Weighted Tc

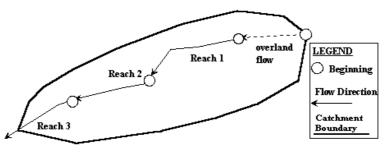
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

ompany: <u>Dakota Springs Engli</u> Date: 8/14/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name BJD-12b

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	295.00	0.028	0.02	23.84
Weighted Totals	295.00	0.028	Total t _i (min)	23.84

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	355.00	0.062	7	3.39
Weighted Totals	355.00	0.062	Total t _t (min)	3.39

Computed t _c (min)	
Regional t _c (min)	28.64
Selected t _c (min)	27.24

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-BJD-12b Weighted Tc

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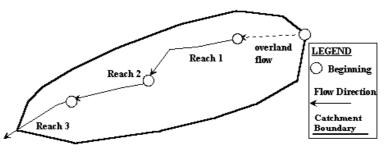
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name BJD-12c

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	300.00	0.330	0.08	10.08
Weighted Totals	300.00	0.330	Total t _i (min)	10.08

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	1104.00	0.015	7	21.46
Weighted Totals	1104.00	0.015	Total t _t (min)	21.46

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	31.54

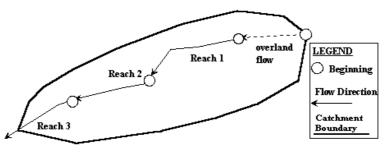
Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name
BJDEX14

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	112.00	0.098	0.08	9.18
Weighted Totals	112.00	0.098	Total t _i (min)	9.18

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	353.00	0.091	7	2.79
Weighted Totals	353.00	0.091	Total t _t (min)	2.79

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	11.96

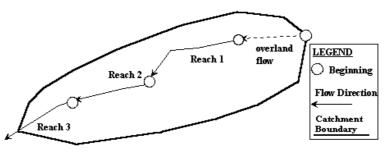
PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-BJDEV14 Weighted Tc

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name JCD OS-1A

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	247.00	0.040	0.02	19.39
			T - 1 - 1 / /// /// ///	
Weighted Totals	247.00	0.040	Total t _i (min)	19.39

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	2545.00	0.045	7	28.56
Weighted Totals	2545.00	0.045	Total t _t (min)	28.56

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	47.96

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCD OS-1A Weighted Tc

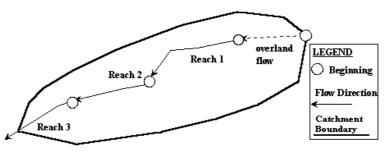
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/21/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	200.00	0.068	0.08	13.84
Weighted Totals	200.00	0.068	Total t _i (min)	13.84

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	1167.00	0.058	7	11.54
Weighted Totals	1167.00	0.058	Total t _t (min)	11.54

Computed t _c (min)	25.37
Regional t _c (min)	
Selected t _c (min)	25.37

EXISTING COND'N-COMPOSITE CALCS.xlsm, Sub-JCD OS-1B Weighted Tc

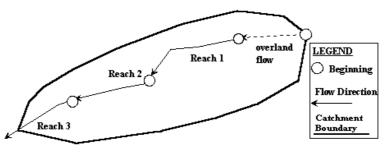
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	300.00	0.083	0.08	15.87
Weighted Totals	300.00	0.083	Total t _i (min)	15.87

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	899.00	0.045	7	10.09
SC-2	1734.00	0.030	7	23.84
Weighted Totals	2633.00	0.035	Total t _t (min)	33.93

Computed t _c (min)	49.79
Regional t _c (min)	52.02
Selected t _c (min)	49.79

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCDEV3.1 Weighted Tc

8/14/2020, 5:33 PM

Version 2.00 released May 2017

	kota Springs Engi	ineering				
ate: 8/1-						
	terview North					
on: <u>NE</u>	Corner at Powers	s Blvd & Bradley Rd.				
	Reach	Reach 2	Reach 1		<u>SEND</u> Beginning w Direction tchment undary	
	bcatchment Nam DEX-3.2	ie	Percent Imperviousness (%) 0			
ov	ERLAND FLOW		,			
	Reach	Overland Flow	Overland Flow	5-yr	Overland Flow	
	ID	Length L _i (ft)	Slope S _i (ft/ft)	Runoff Coefficient, C₅	Time t _i (min)	
OV	ERLAND FLOW	244.00	0.090	0.08	13.93	
	Neighted Totals	244.00	0.090	Total t _i (min)	13.93	
	weighted Totals	244.00	0.090		13.93	
СН	ANNELIZED FLC	w				
		Channelized Flow	Channelized Flow	NRCS	Channelized Flow	
	Reach ID	Length	Slope	Conveyance	Time	
		L _t (ft)	S _t (ft/ft)	Factor K	t _t (min)	
	SC-1	958.00	0.066	7	8.88	

Computed t _c (min)	22.81
Regional t _c (min)	
Selected t _c (min)	22.81

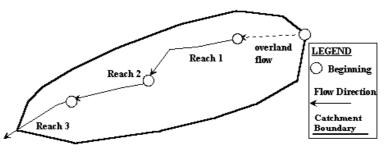
PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCDEV3.2 Weighted Tc

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/14/2020

Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name JCDEX3.3

OVERLAND FLOW

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C ₅	Overland Flow Time t _i (min)
	297.00	0.118	0.08	14.06
Weighted Totals	297.00	0.118	Total t _i (min)	14.06

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	398.00	0.075	7	3.46
Weighted Totals	398.00	0.075	Total t _t (min)	3.46

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	17.52

PRE DEV - UD-RATIONAL 2.00.xlsm, Sub-JCDEV3.3 Weighted Tc

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POST DEVELOPMENT RATIONAL ANALYSIS SUMMARY

WATERVIEW NORTH - POST DEVELOPMENT

(RATIONAL METHOD Q=CIA)

															iA)						
	Т	OTAL	FLOW	V S	AREA	WEIG	ΗΤΕD		O V E	RLANI)			CHA	NNEL			Tc TOTAL	INTE	N S I T Y	
BASIN	Q(5)	Q(100)		equiv.)	TOTAL	C(5)	C(100)	C(5)	Length	Slope	Ti	Length	Slope	Description	Convey	Velocity	Tt	IC IOTAL	I(5)	I(100)	COMMENTS
	(c.f.s.)	(c.f.s.)	5 YR	100 YR	(Ac)				(ft)	(ft)	(min)	(ft)	(%)	Code	Factor (K)	(fps)	(min)	(min)	(in/hr)	(in/hr)	
BJD-12a	8.3	60.6	4.34	19.00	54.28	0.08	0.35	0.08	300	3.7%	21.5	1,784	3.5%	3	7	1.3	22.7	44.2	1.9	3.2	
BJD-12b	2.0		0.76	3.34	9.54	0.08	0.35	0.08	295	2.8%	23.3	377	5.8%	3	7	1.7	3.7	27.1	2.6	4.4	Bypasses Pond BJD-K to DP-BJD-K
BJD-12c	37.2	74.1	10.76	12.76	18.23	0.59	0.70	0.59	100	2.5%	7.0	1,304	1.6%	6	20	2.5	8.6	15.6	3.5	5.8	
BJDEX-14	1.9		0.49	2.16	6.16	0.08	0.35	0.08	112	9.8%	9.5	377	9.1%	3	7	2.1	3.0	12.5	3.8	6.4	Route through JCD-DEV3.3 into Pond A
BJDEV-14	23.9		4.64	5.13	6.16	0.75	0.83	0.75	100	9.5%	3.1	366	8.5%	6	20	5.8	1.0	5.0	5.2	8.7	Future Condition - Qout to Big Johnson Res.
JCD-OS1A	5.2		2.88		36.00	0.08	0.35	0.08	247	4.0%	19.0	2,545	4.6%	3	7	1.5	28.3	47.2	1.8	3.0	
JCD-OS1B	4.5		1.66	7.25	20.70	0.08	0.35	0.08	200	6.8%	14.3	1,167	5.8%	3	7	1.7	11.5	25.9	2.7	4.5	
JCD-DEV3.1	137.2	272.6	41.16	48.71	68.60	0.60	0.71	0.60	100	7.5%	4.8	2,850	3.8%	6	20	3.9	12.2	17.0	3.3	5.6	
JCD-DEV3.2	35.6	67.8	7.93	8.98	13.21	0.60	0.68	0.60	100	10.9%	4.3	1,128	6.9%	6	20	5.3	3.6	7.8	4.5	7.5	
JCD-DEV3.3		70.9	7.60	8.40	10.00	0.76	0.84	0.76	100	6.7%	3.4	733	8.5%	6	20	5.8	2.1	5.5	5.0	8.4	To Pond A
Design Points																					
Pond A	38.2	83.7	8.09	10.56	16.16	0.50	0.65	0.50	100	20.0%	4.2	1,167	14.3%	6	20	7.5	2.6	6.8	4.7	7.9	Pond A Tributary
DP A	1	17																			Pond A Qout (refer to pond calcs)
BJD-12b	2.0		0.76	3.34	9.54	0.08	0.35	0.08	295	2.8%	23.3	377	6.2%	3	7	1.7	3.6	26.9	2.6	4.4	Bypasses Pond BJD-K to DP-BJD-K
BJD-12c	37.2	74.1	10.76	12.76	18.23	0.59	0.70	0.59	100	2.5%	7.0	1,304	1.6%	6	20	2.5	8.6	15.6	3.5	5.8	Pond BJD-K Qin
BJD-K	1.0	9.0																			Pond BJD-K Qout (refer to pond calcs)
'\																					
JCD-DEV3.1	137.2	272.6	41.16	48.71	68.60	0.60	0.71	0.60	100	7.5%	4.8	2,850	3.8%	6	20	3.9	12.2	17.0	3.3	5.6	
JCD-DEV3.	35.6	67.8	7.93	8.98	13.21	0.60	0.68	0.60	100	10.9%	4.3	1,128	6.9%	6	20	5.3	3.6	7.8	4.5	7.5	
POND JCD-D	164		49.09	57.69	81.81	0.60	0.70	0.60	100	7.5%	4.8	2,850	3.8%	6	20	3.9	12.2	17.0	3.3	5.6	POND JCD-D Qin
JCD-OS1.A	5.2	38.1	2.88	12.60	36.00	0.08	0.35	0.08	247	4.0%	19.0	2,545	4.6%	3	7	1.5	28.3	47.2	1.8	3.0	Bypass Pond JCD-D to DP-JCD-D
JCD-OS1.B	4.6	33.6	1.66	7.25	20.70	0.08	0.35	0.08	200	8.5%	13.3	1,167	5.8%	3	1	1.7	11.5	24.8	2.8	4.6	Bypass Pond JCD-D to DP-JCD-D
	\backslash	、 、	7															ID	F Equatio	ns	
r					1	1			2.205	(1 1 0	\sqrt{r}							$I_{100} = -2.5$	$52 \ln(D) + 1$	2.735	
UDFCD Tabl	e 6-2 1	VRCS Con	veyance	Factors, K				$t_i = -$	0.395	(1.1 – C	5)√Li								5 ln(D) + 1		
Code	Descriptio	n			K			-1		S ^{0.33}									$0 \ln(D) + 1$		
1	Heavy me	adow	\backslash		2.5		_					_									
2 Tillage/field $t = \frac{L_t}{L_t}$										5 ln(D) + 8											
$\frac{2}{3} \text{Short pasture and lawns} \qquad 7 \qquad \qquad t_t = \frac{1}{60 K_t} = \frac{1}{60 V_t}$										$\ln(D) + 7.5$											
4 Nearly bare ground 10								-	$\ln(D) + 6.0$												
5	Grassed w	0		$\overline{}$	15		\searrow		tod +	_+ _+								equations m	es calculated b 1ay not precise	ely	
	Paved are	J	llow nave	d swales	20			Jompu	teu t _e	$= t_i + t_t$								duplicate va	alues read from	n figure.	
0		as und sild	now pave	u swates	20			$\overline{}$													

DP BJD-K represents flows going into the existing culvert. Narrative notes the pond outflow and bypass flow does not coincide with each other; therefore DP BJD-K peak flow should be the larger of the two flows which is BJD-12b. Update the narrative and drainage map values.

Provide calculations for Design Point JCD-D which is the cumulative flow from Pond Qout and the bypass flow.

POST DEVELOPMENT WEIGHTED CURVE NUMBER & RUNOFF COEFFICIENT CALCULATIONS

Waterview North

BASIN	Total	HSG		DESIGNATED	LAND USE (% OF	BASIN)	WEIGHTE	D RESULTAN	NT VALUES	ca-equiva	alent	Initial		
ID	Area (Ac.)	A/B	% IMPERV	I-2	COMMERCIAL	RESIDENTIAL	CN	C5	C100	CA5	CA100	Abstraction(la)		
BJD-12a	54.28	А	0.0											
2002 120	0 1.20	,,,	0.0				68.0	0.08	0.35	4.3424	19.00	0.470588235		
BJD-12b	9.54	А	0.0											
							68.0	0.08	0.35	0.7632	3.34	0.470588235		
BJD-12c	18.23	A/B	80.0	18.23										
D0D 120	10.20	70	00.0	1			88	0.59	0.7	10.7557	12.76	0.136363636		
BJDEV-14	6.16	В	91.1	1.61	4.55									
DJDL V-14	0.70	В	91.1	0.26	0.74		91.0	0.75	0.83	4.6354	5.13	0.098901099		
JCD-OS1A	36.00	Δ	0.0											
JCD-031A	30.00	А	A	A	0.0				68.0	0.08	0.35	2.88	12.60	0.470588235
JCD-0S1B	20.70	A/B	0.0											
JCD-031B	20.70	A/D	0.0				71.9	0.08	0.35	1.656	7.25	0.391788448		
JCDEV-3.1	68.60	A/B	82.2	8.36	6.86	53.98								
JODE V-3.1	00.00	AVD	02.2	0.12	0.10	0.79	90.7	0.6	0.71	42.877	48.60	0.102008032		
JCDEV-3.2	13.21	В	80.0			13.21								
JCDEV-3.2	13.21	В	80.0			1.00	90.0	0.60	0.68	7.926	8.98	Abstraction(la) 0.470588235 0.470588235 0.136363636 0.098901099 0.470588235 0.391788448		
JCDEV-3.3	10.00	В	017		7.77	2.23								
JUDEV-3.3	3.3 10.00	В	91.7		0.78	0.22	91.6	0.76	0.84	7.6317	8.35	0.092251567		

Note: Antecedent Runoff Condition = 2, Runoff Coefficients refered from Table 6-6, CNs referenced from Table 6-10 of the DCM.

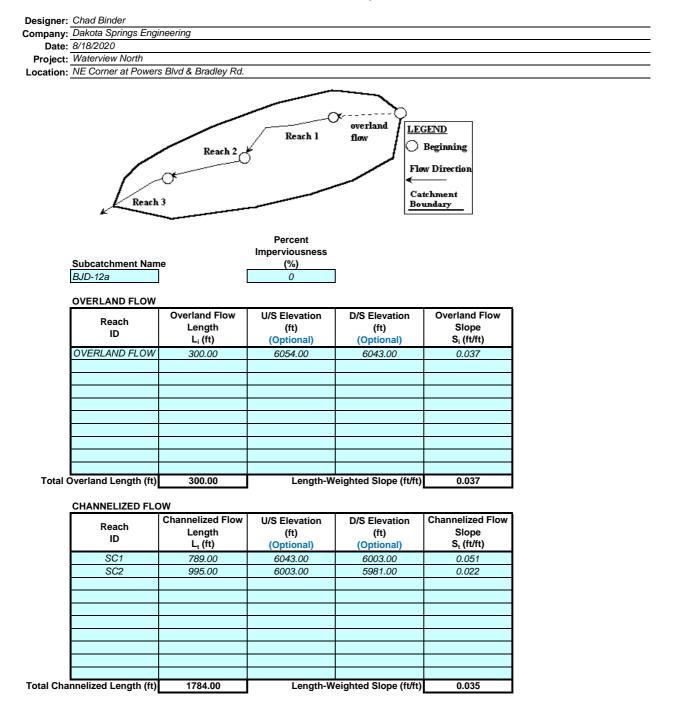
Land Use	% Imp.	5-yr (C)	100-yr (C)	CN	CN
ID		HSG A & B	HSG A & B	HSG A	HSG B
*Brush/Weed/Grass	0	0.08	0.35	68	79
INDUSTRIAL	80	0.59	0.7	81	88
COMMERCIAL	95	0.81	0.88	89	92
**RESIDENTIAL	80	0.6	0.68	82	90

* Offsite Basin land use is Pasture/Meadow For the Rational Analysis and Brush- brush weed grass for the UH Analysis - unless noted otherwise.

** Runoff Coefficients for residential were extrapolated from values shown on Table 6.6(8 units per acre) of the DCM to match proposed density (12 units per acre).

POST DEVELOPMENT RATIONAL ANALYSIS WEIGHTED SLOPE CALCS

Version 2.00 released May 2017



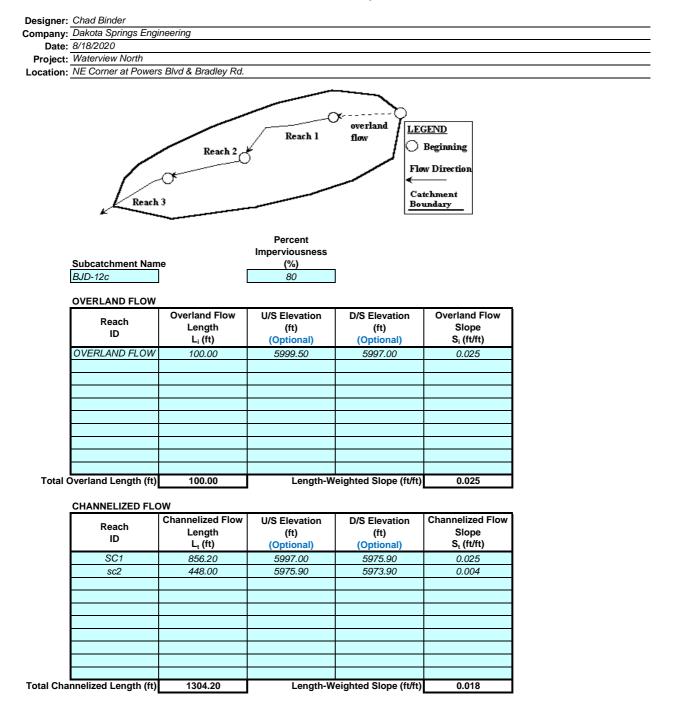
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/18/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJD-12b 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VENEAU 6010.00 6018.30 0.028 295.00 Length-Weighted Slope (ft/ft) 0.028 Total Overland Length (ft) 295.00

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	355.00	6010.00	5988.00	0.062
al Channelized Length (ft)	355.00	Length-W	eighted Slope (ft/ft)	0.062

Version 2.00 released May 2017



Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/18/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. \sim overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2, A Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) BJDEV-14 91.1 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) 100.00 5993.00 0.095 6002.50

Total O	verland Length (ft)	100.00	Length-We	eighted Slope (ft/ft)	0.095
	-		-	-	

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	365.50	5993.00	5962.00	0.085
Total Channelized Length (ft)	365.50	Length-W	eighted Slope (ft/ft)	0.085

Version 2.00 released May 2017

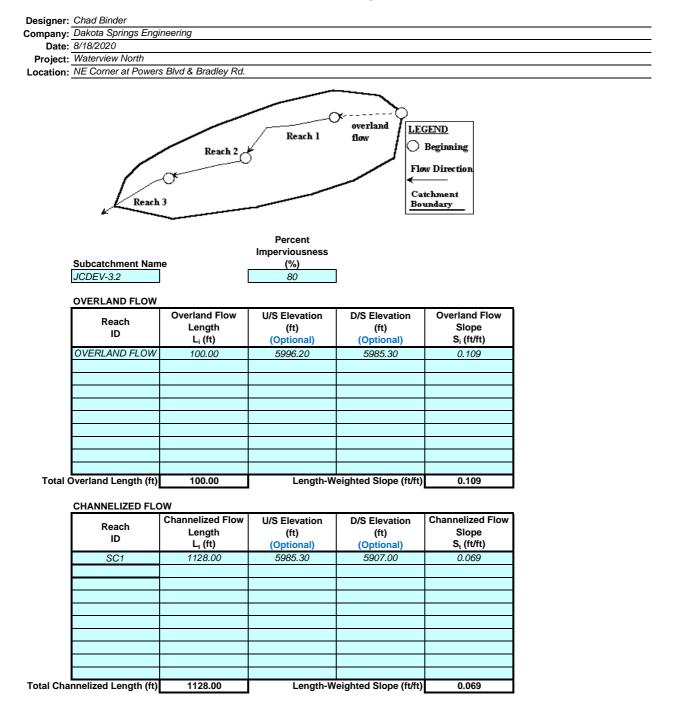
Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/18/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) JCDEV-3.1 82.2 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VENEAN 100.00 5996.00 5988.50 0.075 100.00 Length-Weighted Slope (ft/ft) 0.075 Total Overland Length (ft)

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	2850.00	5988.50	5879.30	0.038
Total Channelized Length (ft)	2850.00	Longth W	eighted Slope (ft/ft)	0.038

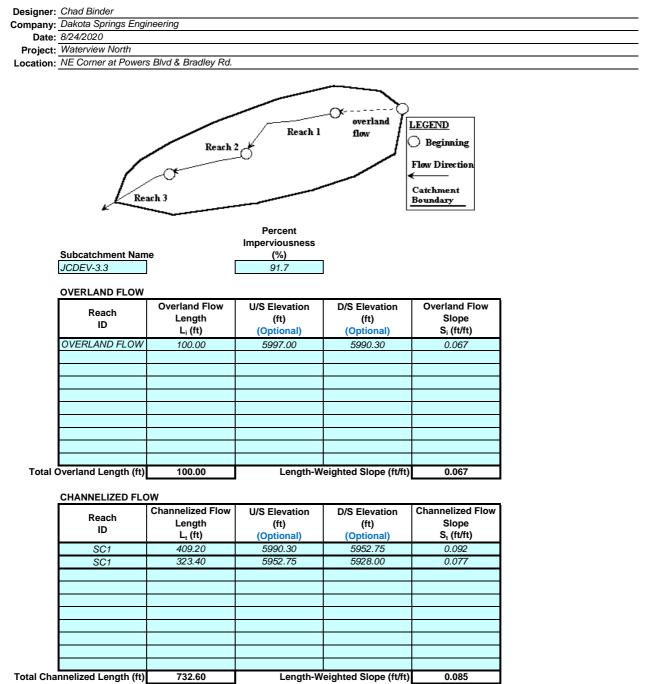
POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.1 Weighted Slope

Version 2.00 released May 2017



POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.2 Weighted Slope

Version 2.00 released May 2017



732.60 Total Channelized Length (ft)

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.3 Weighted Slope

Version 2.00 released May 2017

y: Dakota Springs Engi	neering			
e: 3/28/2020				
t: Waterview North				
n: NE Corner at Powers	Blvd & Bradley Rd.			
Reach	Reach 2	Reach 1		GEND Beginning ow Direction atchment pundary
		Imperviousness		
Subcatchment Nam	ie .	(%)		
JCD-OS1A		5		
OVERLAND FLOW				
Reach	Overland Flow	U/S Elevation	D/S Elevation	Overland Flow
ID	Length	(ft)	(ft)	Slope
	L _i (ft)	(Optional)	(Optional)	S _i (ft/ft)
OVERLAND FLOW	247.00	6076.00	6066.00	0.040
I Overland Length (ft)	247.00	Length-We	eighted Slope (ft/ft) 0.040
CHANNELIZED FLC	OW Channelized Flow			Channeline d Elec
	Channelized Flow	U/S Elevation	D/S Elevation	Channelized Flow
Reach		(#4)		
Reach ID	Length	(ft)	(ft)	Slope S. (ff/ff)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
	Length			
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)
ID	Length L _t (ft)	(Optional)	(Optional)	S _t (ft/ft)

Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering Date: 8/18/2020 Project: Waterview North Location: NE Corner at Powers Blvd & Bradley Rd. overland **LEGEND** Reach 1 flaw 🔿 Beginning Reach 2 ,-Flow Direction Catchment . Reach 3 Boundary Percent Imperviousness Subcatchment Name (%) JCD-0S1B 0 OVERLAND FLOW **Overland Flow** U/S Elevation D/S Elevation Overland Flow Reach Slope Length (ft) (ft) ID S_i (ft/ft) (Optional) L_i (ft) (Optional) VLNLAV 6013.50 6000.00 0.068 200.00

Total C	verland Length (ft)	200.00	Length-We	eighted Slope (ft/ft)	0.068

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)
SC1	1167.00	6000.00	5932.00	0.058
Total Channelized Length (ft	1167.00	Length-W	eighted Slope (ft/ft)	0.058

POST DEVELOPMENT RATIONAL ANALYSIS WEIGHTED Tc CALCS

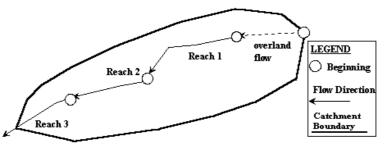
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name BJD-12a

OVERLAND FLOW				
Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	300.00	0.037	0.08	20.71
Weighted Totals	300.00	0.037	Total t _i (min)	20.71

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	789.00	0.049	7	8.49
SC-2	995.00	0.022	7	15.97
Weighted Totals	1784.00	0.034	Total t _t (min)	24.46

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	43.93

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-BJD-12a Weighted Tc

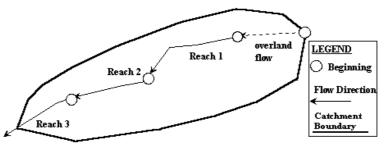
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name BJD-12b

OVERLAND FLOW				
Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	295.00	0.028	0.08	22.52
Weighted Totals	295.00	0.028	Total t _i (min)	22.52

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	355.00	0.062	7	3.39
Weighted Totals	355.00	0.062	Total t _t (min)	3.39

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	25.91

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-BJD-12b Weighted Tc

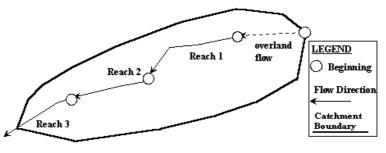
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





OVERLAND FLOW

BJD-12c

Subcatchment Name

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	100.00	0.025	0.59	6.81
Weighted Totals	100.00	0.025	Total t _i (min)	6.81

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	856.20	0.022	20	4.81
SC-2	448.00	0.004	10	11.81
Weighted Totals	1304.20	0.016	Total t _t (min)	16.62

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	20.96

POST DEV - COMPOSITE CALCS 2.00.xlsm, Weighted Tc

8/18/2020, 4:32 PM

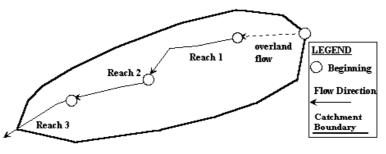
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





OVERLAND FLOW

BJDEV-14

Subcatchment Name

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	100.00	0.095	0.75	3.01
Weighted Totals	100.00	0.095	Total t _i (min)	3.01

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	365.50	0.085	20	1.04
Weighted Tatala	205 50	0.005	Total t (min)	1.04
Weighted Totals	365.50	0.085	Total t _t (min)	1.04

Computed t _c (min)	
Regional t _c (min)	
Selected t _c (min)	5.00

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-BJDEV-14 Weighted Tc

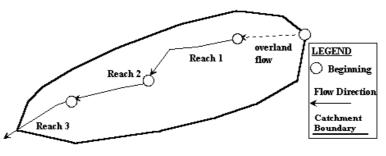
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

ompany: <u>Dakota Springs Engineen</u> Date: 8/19/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





OVERLAND FLOW

JCDEV3.1

Subcatchment Name

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	100.00	0.075	0.60	4.64
Weighted Totals	100.00	0.075	Total t _i (min)	4.64

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	2850.00	0.038	20	12.18
		0.000	Tatal (min)	10.10
Weighted Totals	2850.00	0.038	Total t _t (min)	12.18

Computed t _c (min)	16.83
Regional t _c (min)	23.91
Selected t _c (min)	16.83

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.1 Weighted Tc

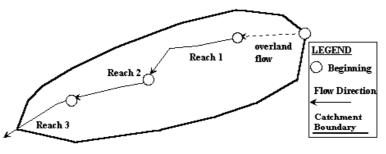
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name JCDEV3.2

OVERLAND FLOW				
Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	100.00	0.109	0.60	4.10
Weighted Totals	100.00	0.109	Total t _i (min)	4.10

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	1128.00	0.069	20	3.58
	4400.00	0.000	Tatal (min)	0.50
Weighted Totals	1128.00	0.069	Total t _t (min)	3.58

Computed t _c (min)	7.68
Regional t _c (min)	15.94
Selected t _c (min)	7.68

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.2 Weighted Tc

Version 2.00 released May 2017

	akota Springs Engi	neering			
	/24/2020				
	/aterview North				
n: <u>N</u>	E Corner at Powers	s Blvd & Bradley Rd.			
	Reach	Reach 2	Reach 1		FEND Beginning w Direction tchment undary
	ubcatchment Nam	le	Percent Imperviousness (%) 91.7		
	VERLAND FLOW				
	Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
0	VERLAND FLOW	100.00	0.067	0.76	3.28
	Weighted Totals	100.00	0.067	Total t _i (min)	3.28
C	HANNELIZED FLC	W			
	Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
	SC-1	732.60	0.085	20	2.09
	Weighted Totals	732.60	0.085	Total t _t (min)	2.09

Computed t _c (min)	5.37
Regional t _c (min)	
Selected t _c (min)	5.37

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCDEV3.3 Weighted Tc

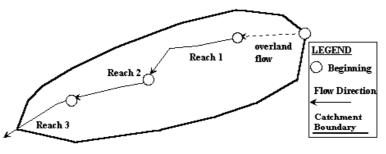
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





OVERLAND FLOW

JCD-OS1A

Subcatchment Name

Reach ID	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	5-yr Runoff Coefficient, C₅	Overland Flow Time t _i (min)
	247.00	0.040	0.08	18.32
Weighted Totals	247.00	0.040	Total t _i (min)	18.32

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	2545.00	0.046	7	28.25
Weighted Totale	0545.00	0.040	Total t (min)	00.05
Weighted Totals	2545.00	0.046	Total t _t (min)	28.25

Computed t _c (min)	
Regional t _c (min)	47.97
Selected t _c (min)	46.57

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCD-OS1A Weighted Tc

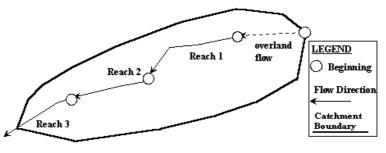
Version 2.00 released May 2017

Designer: Chad Binder Company: Dakota Springs Engineering

Date: 8/18/2020

Project: Waterview North

Location: NE Corner at Powers Blvd & Bradley Rd.





Subcatchment Name JCD-OS1B

OVERLAND FLOW 5-yr Runoff **Overland Flow Overland Flow** Overland Flow Reach Time Length Slope ID t_i (min) S_i (ft/ft) Coefficient, C₅ L_i (ft) VENEAN 200.00 0.068 0.08 13.84 Weighted Totals 200.00 0.068 Total t_i (min) 13.84

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L _t (ft)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t _t (min)
SC-1	1167.00	0.058	7	11.54
Weighted Totals	1167.00	0.058	Total t, (min)	11.54

Computed t _c (min)	25.37
Regional t _c (min)	
Selected t _c (min)	25.37

POST DEV - COMPOSITE CALCS 2.00.xlsm, Sub-JCD OS-1B Weighted Tc

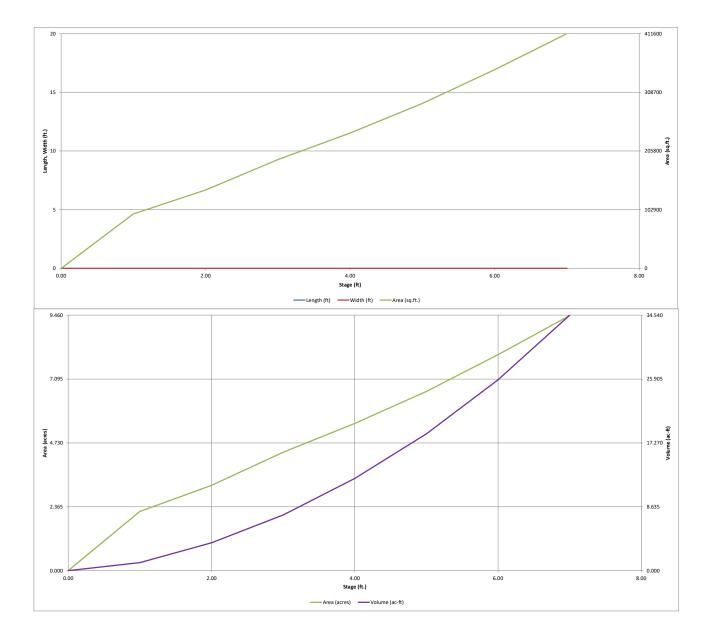
APPENDIX C

DETENTION CALCULATIONS
WATER QUALITY CALCULATIONS

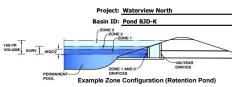
EX. OFFSITE POND FED BY OFFSITE BASIN BJD-12A

			MHFD	-Detention, Version	4.02 (Febr	uary 2020)							
	Waterview I												
Basin ID:	JCD-12a - 0	FFSITE POND											
ZONE	2 ONE 1												
		\square	_										
T T Mach						1							
PERMANENT ORIFI	1 AND 2	100-YEAR ORIFICE		Depth Increment =	1.00	ft Optional			1	Optional			
		on (Retention Pond)		Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volume
Webserbad Tefermetice		and Oarba		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft ²)	Area (ft ²)	(acre)	(ft 3)	(ac-ft)
Watershed Information	Flood Cont No BMP			Media Surface		0.00				0	0.000	47.001	1.005
Selected BMP Type = Watershed Area =	57.11					1.00 2.00				95,389 137,419	2.190 3.155	47,691	3.767
		acres										164,095	
Watershed Length = Watershed Length to Centroid =	2,331 1,307	ft				3.00				190,906 237,452	4.383 5.451	328,257 542,436	7.536 12.453
Watershed Slope =	0.026	ft/ft				5.00				289,141	6.638	805,733	18.497
Watershed Imperviousness =	5.00%	percent				6.00				348,285	7.996	1,124,446	25.814
Percentage Hydrologic Soil Group A =	100.0%	percent				7.00				411,513	9.447	1,504,345	34.535
Percentage Hydrologic Soil Group B =	0.0%	percent											
Percentage Hydrologic Soil Groups C/D =	0.0%	percent											
Target WQCV Drain Time =		hours											
Location for 1-hr Rainfall Depths =													
After providing required inputs above in depths, click 'Run CUHP' to generate run	cluding 1-hour off hydrograph	rainfall s using											
the embedded Colorado Urban Hydro			r Overrides										
Water Quality Capture Volume (WQCV) =	0.172	acre-feet	acre-feet										
Excess Urban Runoff Volume (EURV) =	0.173	acre-feet	acre-feet										
2-yr Runoff Volume (P1 = 1.19 in.) =	0.085	acre-feet 1.19	inches										
5-yr Runoff Volume (P1 = 1.5 in.) =	0.155	acre-feet 1.50	inches										
10-yr Runoff Volume (P1 = 1.75 in.) =	0.215	acre-feet 1.75	inches										
25-yr Runoff Volume (P1 = 2 in.) = 50-yr Runoff Volume (P1 = 2.25 in.) =	0.907	acre-feet 2.00 acre-feet 2.25	inches inches										
100-yr Runoff Volume (P1 = 2.25 iii.) = 100 -yr Runoff Volume (P1 = 2.52 iii.) =	2.685	acre-feet 2.52	inches										
500-yr Runoff Volume (P1 = 3.14 in.) =		acre-feet	inches										
Approximate 2-yr Detention Volume =	0.100	acre-feet	-										
Approximate 5-yr Detention Volume =	0.140	acre-feet											_
Approximate 10-yr Detention Volume =	0.191	acre-feet											
Approximate 25-yr Detention Volume =	0.270	acre-feet											
Approximate 50-yr Detention Volume =	0.440	acre-feet											
Approximate 100-yr Detention Volume =	0.906	acre-feet											
Define Zones and Basin Geometry													
Select Zone 1 Storage Volume (Required) =		acre-feet											
Select Zone 2 Storage Volume (Optional) =		acre-feet											
Select Zone 3 Storage Volume (Optional) =		acre-feet											
Total Detention Basin Volume =		acre-feet											
Initial Surcharge Volume (ISV) =	N/A	ft ³											
Initial Surcharge Depth (ISD) =	N/A	ft											
Total Available Detention Depth $(H_{total}) =$ Depth of Trickle Channel $(H_{TC}) =$	user	ft ft											
Slope of Trickle Channel (S_{TC}) =	user	ft/ft											
Slopes of Main Basin Sides (S _{main}) =	user	H:V											
Basin Length-to-Width Ratio (RL/W) =	user												
Initial Surcharge Area $(A_{ISV}) =$	user	ft ²											
Surcharge Volume Length $(L_{ISV}) =$	user	ft											
Surcharge Volume Width (W _{ISV}) =	user	ft											
Depth of Basin Floor (H_{FLOOR}) = Length of Basin Floor (L_{FLOOR}) =	user	ft											
Width of Basin Floor (W_{FLOOR}) =	user	ft											
Area of Basin Floor (A _{FLOOR}) =	user	ft ²											
Volume of Basin Floor (V _{FLOOR}) =	user	ft ³											
Depth of Main Basin (H_{MAIN}) =	user	ft											
Length of Main Basin (L _{MAIN}) =	user	ft											
Width of Main Basin (W_{MAIN}) = Area of Main Basin (A_{MAIN}) =	user	ft ft ²											
Area of Main Basin (A _{MAIN}) = Volume of Main Basin (V _{MAIN}) =	user	ft ²											
Calculated Total Basin Volume (V _{total}) =		acre-feet											
(total)		-											
						1					1		

MHFD-Detention, Version 4.02 (February 2020)



POND DESIGN & ANALYSIS Proposed Pond BJD-K



Depth Increment = 0.60 ft

Watershed Informa	tion

lersneu miormation		
Selected BMP Type =	EDB	
Watershed Area =	18.23	acres
Watershed Length =	1,403	ft
Watershed Length to Centroid =	778	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	17.3%	percent
Percentage Hydrologic Soil Group B =	82.7%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

the embedded colorado orban nyare	graphinoccut	ii C.	Optional User	Override
Water Quality Capture Volume (WQCV) =	0.499	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.671	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.422	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.882	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.257	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.690	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.084	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.543	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.535	acre-feet		inches
Approximate 2-yr Detention Volume =	1.279	acre-feet		-
Approximate 5-yr Detention Volume =	1.681	acre-feet		
Approximate 10-yr Detention Volume =	2.073	acre-feet		4
Approximate 25-yr Detention Volume =	2.261	acre-feet		
Approximate 50-yr Detention Volume =	2.371	acre-feet		
Approximate 100-yr Detention Volume =	2.509	acre-feet		

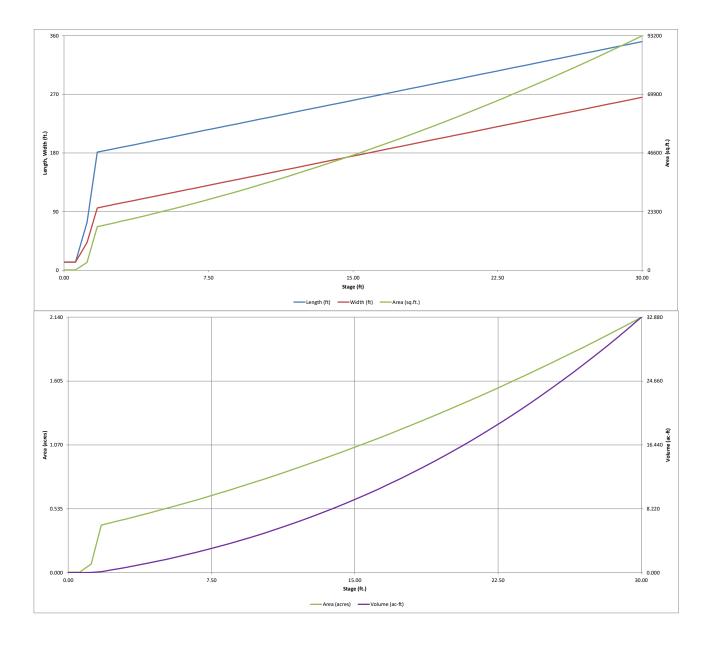
Define Zones and Basin Geometry

The Eones and Basin Scomedy		
Zone 1 Volume (WQCV) =	0.499	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.172	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.838	acre-feet
Total Detention Basin Volume =	2.509	acre-feet
Initial Surcharge Volume (ISV) =	65	ft ³
Initial Surcharge Depth (ISD) =	0.40	ft
Total Available Detention Depth (H _{total}) =	6.50	ft
Depth of Trickle Channel (H _{TC}) =	0.50	ft
Slope of Trickle Channel (S _{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S _{main}) =	3	H:V
Basin Length-to-Width Ratio (R _{L/W}) =	2	
		•
Initial Surcharge Area (Area) =	163	ff ²

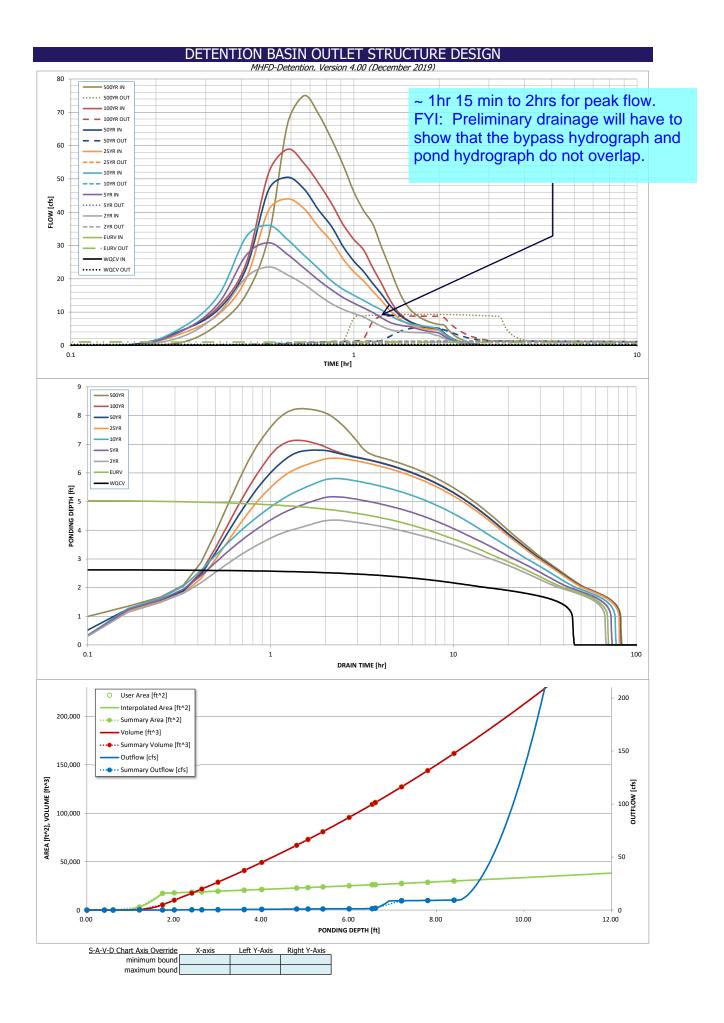
Initial Surcharge Area $(A_{ISV}) =$	163	ft*
Surcharge Volume Length $(L_{ISV}) =$	12.8	ft
Surcharge Volume Width (W_{ISV}) =	12.8	ft
Depth of Basin Floor $(H_{FLOOR}) =$	0.83	ft
Length of Basin Floor $(L_{FLOOR}) =$	181.3	ft
Width of Basin Floor (W _{FLOOR}) =	95.8	ft
Area of Basin Floor (A _{FLOOR}) =	17,358	ft ²
Volume of Basin Floor (V _{FLOOR}) =	5,313	ft ³
Depth of Main Basin $(H_{MAIN}) =$	4.77	ft
Length of Main Basin $(L_{MAIN}) =$	209.9	ft
Width of Main Basin (W_{MAIN}) =	124.4	ft
Area of Main Basin $(A_{MAIN}) =$	26,105	ft 2
Volume of Main Basin (V _{MAIN}) =	102,953	ft ³
Calculated Total Basin Volume (V_{total}) =	2.489	acre-feet

		Depth Increment =	0.60	ft			1	Ontional			
ond)		Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volume
,		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft 2)	Area (ft ²)	(acre)	(ft 3)	(ac-ft)
		Top of Micropool	0.00		12.8	12.8	163		0.004		
		ISV	0.40		12.8	12.8	163		0.004	65	0.00150
			0.60		12.8	12.8	163		0.004	98	0.00224
		Floor	1.20 1.73		73.7 181.3	42.8 95.8	3,150 17,358		0.072	552 5,483	0.01268 0.12588
		11001	1.80		181.7	96.2	17,474		0.401	6,702	0.15387
			2.40		185.3	99.8	18,488		0.424	17,490	0.40151
		Zone 1 (WQCV)	2.63		186.7	101.2	18,883		0.433	21,787	0.50017
			3.00		188.9	103.4	19,527		0.448	28,893	0.66329
			3.60		192.5 196.1	107.0	20,592		0.473	40,927	0.93956
			4.20 4.80		196.1	110.6 114.2	21,683 22,800		0.498	53,608 66,952	1.23068 1.53701
		Zone 2 (EURV)	5.06		201.2	111.2	23,292		0.525	72,944	1.67456
			5.40		203.3	117.8	23,943		0.550	80,974	1.85890
tional Use	r Overrides		6.00		206.9	121.4	25,112		0.576	95,689	2.19671
	acre-feet	Zone 3 (100-year)	6.53		210.1	124.6	26,166		0.601	109,276	2.50863
1.10	acre-feet		6.60		210.5	125.0	26,306		0.604	111,113	2.55079
1.19 1.50	inches inches		7.20		214.1 217.7	128.6 132.2	27,527 28,773		0.632	127,261 144,150	2.92152 3.30923
1.75	inches		8.40		221.3	135.8	30,046		0.690	161,795	3.71429
2.00	inches		9.00		224.9	139.4	31,344		0.720	180,210	4.13706
2.25	inches		9.60		228.5	143.0	32,669		0.750	199,413	4.57789
2.52	inches		10.20		232.1	146.6	34,019		0.781	219,418	5.03714
	inches		10.80 11.40		235.7 239.3	150.2 153.8	35,395 36,797		0.813	240,241 261,897	5.51516 6.01232
			11.40		239.3	153.8	36,797		0.845	284,402	6.52897
	4.12		12.60		246.5	161.0	39,679		0.911	307,772	7.06547
			13.20		250.1	164.6	41,159		0.945	332,022	7.62217
			13.80		253.7	168.2	42,664		0.979	357,167	8.19944
			14.40		257.3	171.8	44,196		1.015	383,224	8.79762
			15.00 15.60		260.9 264.5	175.4 179.0	45,754 47,337		1.050	410,208 438,134	9.41708 10.05817
			16.20		268.1	182.6	48,947		1.124	467,018	10.72125
			16.80		271.7	186.2	50,582		1.161	496,875	11.40668
			17.40		275.3	189.8	52,243		1.199	527,721	12.11481
			18.00		278.9	193.4	53,930		1.238	559,572	12.84600
			18.60		282.5	197.0	55,643		1.277	592,443	13.60061
			19.20 19.80		286.1 289.7	200.6 204.2	57,382 59,147		1.317 1.358	626,349 661,307	14.37900 15.18151
			20.40		293.3	201.2	60,938		1.399	697,331	16.00852
			21.00		296.9	211.4	62,755		1.441	734,438	16.86037
			21.60		300.5	215.0	64,598		1.483	772,642	17.73743
			22.20		304.1	218.6	66,466		1.526	811,960	18.64004
			22.80		307.7	222.2	68,361		1.569	852,407	19.56857
			23.40 24.00		311.3 314.9	225.8 229.4	70,281 72,228		1.613 1.658	893,998 936,750	20.52338 21.50482
			24.60		318.5	233.0	74,200		1.703	980,677	22.51324
			25.20		322.1	236.6	76,198		1.749	1,025,795	23.54901
			25.80		325.7	240.2	78,222		1.796	1,072,120	24.61248
			26.40		329.3	243.8	80,272		1.843	1,119,667	25.70402
			27.00 27.60		332.9 336.5	247.4 251.0	82,348 84,450		1.890 1.939	1,168,452 1,218,490	26.82396 27.97269
			28.20		340.1	254.6	86,578		1.988	1,210,190	29.15054
			28.80		343.7	258.2	88,732		2.037	1,322,389	30.35788
			29.40		347.3	261.8	90,911		2.087	1,376,281	31.59506
			30.00		350.9	265.4	93,117		2.138	1,431,488	32.86244
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MHFD-Detention, Version 4.02 (February 2020)



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-	Waterview North Pond BJD-K								
ZONE 3	Pona BJD-K								
ZONE 2 ZONE 1	\frown			Estimated	Estimated				
100.YB				Stage (ft)	Volume (ac-ft)	Outlet Type			
			Zone 1 (WQCV)	2.63	0.499	Orifice Plate			
	100-YEAR		Zone 2 (EURV)	5.06	1.172	Orifice Plate	1		
PERMANENT ORIFICES	ORIFICE		Zone 3 (100-year)	6.53	0.838	Weir&Pipe (Restrict)			
T ETHIOTETT	Configuration (Re		2011e 5 (100-year)			wend ipe (Resulet)]		
•	•			Total (all zones)	2.509]			
User Input: Orifice at Underdrain Outlet (typical	-		,				r	ters for Underdrain	
Underdrain Orifice Invert Depth =	N/A	ft (distance below	the filtration media	surface)		drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrair	n Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more orific	es or Elliptical Slot	Weir (typically used	to drain WQCV and	/or EURV in a sed	imentation BMP)		Calculated Parame	ters for Plate	
Invert of Lowest Orifice =	0.00	ft (relative to basin	bottom at Stage =	0 ft)	WQ Orif	ice Area per Row =	N/A	ft ²	
Depth at top of Zone using Orifice Plate =	5.00	ft (relative to basin	bottom at Stage =	0 ft)	Elli	iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches			Ellipt	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	inches				Iliptical Slot Area =	N/A	ft ²	
	,						,	1.4	
User Input: Stage and Total Area of Each Orifice	Row (numbered f	rom lowest to high	ect)						
SSS. Input: Stage and Total Area of Each Office	Row 1 (required)			Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Pow 7 (optional)	Pow 8 (optional)	1
		Row 2 (optional)	Row 3 (optional)		Now 5 (optional)		Row 7 (optional)	Row 8 (optional)	
Stage of Orifice Centroid (ft)	0.00	2.00	3.00	3.75					1
Orifice Area (sq. inches)	2.20	6.00	6.00	6.00					1
			I			1		1	1
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	
Stage of Orifice Centroid (ft)									
Orifice Area (sq. inches)]
User Input: Vertical Orifice (Circular or Rectange	ular <u>)</u>						Calculated Parame	ters for Vertical Ori	fice
	Not Selected	Not Selected					Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin	bottom at Stage =	= 0 ft) Ve	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin	bottom at Stage =	= 0 ft) Vertica	l Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A		inches	5	,		,	,	1
User Input: Overflow Weir (Dropbox with Flat o	r Clanad Crata and	Outlot Dino OD Doc	tangular/Trangzoid	al Wair (and No Ou	itlat Dina)		Calculated Darama	ters for Overflow W	loir
Osei Input. Overnow wen (Dropbox with riat o	Sloped Grate and	Outlet Fipe OK Ket							
	7 2 14/ 1				luct ripe)				1
	Zone 3 Weir	Not Selected					Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.53	N/A	ft (relative to basin b		t) Height of Grat	e Upper Edge, H _t =	Zone 3 Weir 7.78	Not Selected N/A	feet
Overflow Weir Front Edge Length =	6.53 8.00	N/A N/A	ft (relative to basin b feet	ottom at Stage = 0 f	t) Height of Grat Overflow W	e Upper Edge, H _t = /eir Slope Length =	Zone 3 Weir 7.78 5.15	Not Selected N/A N/A	
	6.53	N/A N/A	ft (relative to basin b	ottom at Stage = 0 f	t) Height of Grat Overflow W	e Upper Edge, H _t =	Zone 3 Weir 7.78	Not Selected N/A	feet
Overflow Weir Front Edge Length =	6.53 8.00	N/A N/A	ft (relative to basin b feet	ottom at Stage = 0 f Gr	t) Height of Grat Overflow W ate Open Area / 10	e Upper Edge, H _t = /eir Slope Length =	Zone 3 Weir 7.78 5.15	Not Selected N/A N/A	feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	6.53 8.00 4.00	N/A N/A N/A	ft (relative to basin b feet H:V	ottom at Stage = 0 f Gr Ov	t) Height of Grat Overflow W rate Open Area / 10 verflow Grate Open	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area =	Zone 3 Weir 7.78 5.15 46.99	Not Selected N/A N/A N/A	feet feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	6.53 8.00 4.00 5.00	N/A N/A N/A N/A	ft (relative to basin b feet H:V feet	ottom at Stage = 0 f Gr Ov	t) Height of Grat Overflow W rate Open Area / 10 verflow Grate Open	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris =	Zone 3 Weir 7.78 5.15 46.99 28.86	Not Selected N/A N/A N/A N/A	feet feet ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % =	6.53 8.00 4.00 5.00 70%	N/A N/A N/A N/A N/A	ft (relative to basin b feet H:V feet %, grate open area	ottom at Stage = 0 f Gr Ov	t) Height of Grat Overflow W rate Open Area / 10 verflow Grate Open	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris =	Zone 3 Weir 7.78 5.15 46.99 28.86	Not Selected N/A N/A N/A N/A	feet feet ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % =	6.53 8.00 4.00 5.00 70% 0%	N/A N/A N/A N/A N/A N/A	ft (relative to basin b feet H:V feet %, grate open area %	ottom at Stage = 0 f Gr Ov	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86	Not Selected N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R	N/A N/A N/A N/A N/A N/A estrictor Plate, or R	ft (relative to basin b feet H:V feet %, grate open area %	ottom at Stage = 0 f Gr Ov	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open	e Upper Edge, $H_t =$ /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 5 for Outlet Pipe w/	Not Selected N/A N/A N/A N/A N/A Elow Restriction Pl	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = <u>User Input: Outlet Pipe w/ Flow Restriction Plate</u>	6.53 8.00 4.00 5.00 70% 0% (<u>Circular Orifice, R</u> Zone 3 Restrictor	N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected	ft (relative to basin b feet H:V feet %, grate open area % ectangular Orifice)	ottom at Stage = 0 f Gr Ov a/total area C	t) Height of Grat Overflow V ate Open Area / 10 verflow Grate Open Overflow Grate Open Overflow Grate Ope	e Upper Edge, H _t = /eir Slope Length = J0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor	Not Selected N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected	feet feet ft ² ft ² ate
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = <u>User Input: Outlet Pipe w/ Flow Restriction Plate</u> Depth to Invert of Outlet Pipe =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00	N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A	ft (relative to basin b feet H:V feet %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba	ottom at Stage = 0 f Gr Ov a/total area C	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open <u>Ca</u> = 0 ft) O	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 s for Outlet Pipe w// Zone 3 Restrictor 0.61	Not Selected N/A N/A N/A N/A N/A Flow Restriction PI Not Selected N/A	feet feet ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = <u>User Input: Outlet Pipe w/ Flow Restriction Plate</u> Depth to Invert of Outlet Pipe = Outlet Pipe Diameter =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00	N/A N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches	ottom at Stage = 0 f Gr Ot a/total area C sin bottom at Stage	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open <u>Cr</u> = 0 ft) O Outle	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29	Not Selected N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = <u>User Input: Outlet Pipe w/ Flow Restriction Plate</u> Depth to Invert of Outlet Pipe =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00	N/A N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba	ottom at Stage = 0 f Gr Ot a/total area C sin bottom at Stage	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open <u>Cr</u> = 0 ft) O Outle	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 s for Outlet Pipe w// Zone 3 Restrictor 0.61	Not Selected N/A N/A N/A N/A N/A Flow Restriction PI Not Selected N/A	feet feet ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00	N/A N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches	ottom at Stage = 0 f Gr Ot a/total area C sin bottom at Stage	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Overflow Grate Open <u>Cr</u> = 0 ft) O Outle	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 S for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05	Not Selected N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A N/A	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or	6.53 8.00 4.00 5.00 70% 0% (<u>Circular Orifice, R</u> Zone 3 Restrictor 2.00 24.00 6.00	N/A N/A N/A N/A N/A N/A Not Selected N/A N/A	ft (relative to basin b feet H:V %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches inches	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent	t) Height of Grat Overflow V ate Open Area / 10 verflow Grate Open Dverflow Grate Open <u>Ca</u> = 0 ft) 0 Outle ral Angle of Restric	e Upper Edge, H _t = /eir Slope Length = 00-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05 Calculated Parame	Not Selected N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A N/A N/A	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage=	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52	N/A N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Dverflow Grate Open Cate = 0 ft) O Outle ral Angle of Restric Spillway D	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = resign Flow Depth =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91	Not Selected N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A N/A N/A ters for Spillway feet	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage= Spillway Crest Length =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52 18.00	N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A ft (relative to basin feet	ft (relative to basin b feet H:V %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches inches	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent	t) Height of Grat Overflow V ate Open Area / 10 verflow Grate Open Overflow Grate Open Overflow Grate Open Car = 0 ft) O Uutle ral Angle of Restric Spillway D Stage at	e Upper Edge, H _t = /eir Slope Length = J0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = vesign Flow Depth = Fop of Freeboard =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 200 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91 10.43	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A ters for Spillway feet feet	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52 18.00 4.00	N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A ft (relative to basin feet H:V	ft (relative to basin b feet H:V %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches inches	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent	t) Height of Grat Overflow V ate Open Area / 10 verflow Grate Open Overflow Grate Open Car = 0 ft) O Uutle ral Angle of Restrict Spillway D Stage at Basin Area at	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = resign Flow Depth = Top of Freeboard = Top of Freeboard =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91 10.43 0.79	Not Selected N/A N/A N/A N/A N/A N/A Not Selected N/A N/A N/A ters for Spillway feet feet acres	feet feet ft ² ft ² ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage= Spillway Crest Length =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52 18.00	N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A N/A ft (relative to basin feet	ft (relative to basin b feet H:V %, grate open area % <u>ectangular Orifice)</u> ft (distance below ba inches inches	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent	t) Height of Grat Overflow V ate Open Area / 10 verflow Grate Open Overflow Grate Open Car = 0 ft) O Uutle ral Angle of Restrict Spillway D Stage at Basin Area at	e Upper Edge, H _t = /eir Slope Length = J0-yr Orifice Area = Area w/o Debris = n Area w/ Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = vesign Flow Depth = Fop of Freeboard =	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 200 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91 10.43	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A ters for Spillway feet feet	feet feet ft ² ft ² ft ² ft ²
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Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage= Spillway Crest Length = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Dethevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52 18.00 4.00 1.00 The user can over: WOCV N/A 0.499 N/A N/A N/A N/A Plate N/A N/A 43	N/A N/A N/A N/A N/A N/A estrictor Plate, or R N/A N/A N/A N/A fet (relative to basin feet H:V feet H:V feet M/A 1.671 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % ectangular Orifice) ft (distance below ba inches inches bottom at Stage = //P hydrographs anc 2 Year 1.19 1.422 1.422 0.6 0.03 2.3.5 0.9 N/A Plate N/A N/A 62	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent 0 ft) 1.882 1.882 1.882 1.882 1.882 1.882 1.882 1.1 0.20 30.8 1.1 0.3 Plate N/A 65	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Nerflow Grate Open Overflow Grate Open Ca = 0 ft) O Outle ral Angle of Restrict Spillway D Stage at Basin Area at Basin Area at Basin Volume at (entering new valu 10 Year 1.75 2.257 6.0 0.33 36.0 1.2 0.2 Plate N/A 68	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/o Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = lesign Flow Depth = Top of Freeboard = Top of Freeboard = Top of Freeboard = Top of Freeboard = 10 of Freeboard = 11.7 0.64 44.0 1.3 0.1 Plate N/A 70	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91 10.43 0.79 5.22 drographs table (CC 50 Year 2.25 3.084 3.084 15.1 0.83 50.5 5.4 0.4 Overflow Weir 1 0.1 N/A 69	Not Selected N/A N/A N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A N/A N/A N/A ters for Spillway feet feet acres acre-ft cumns W through A 100 Year 2.52 3.543 3.543 19.7 1.08 58.9 8.8 0.4 Outlet Plate 1 0.3 N/A 68	feet feet ft ² ft ² ft ² feet radians 500 Year 3.14 4.535 4.535 27.9 1.53 75.0 9.3 0.3 0.3 Outlet Plate 1 0.3 N/A 65
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Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Spillway Invert Stage= Spillway Crest Length = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Dethevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	6.53 8.00 4.00 5.00 70% 0% (Circular Orifice, R Zone 3 Restrictor 2.00 24.00 6.00 Trapezoidal) 8.52 18.00 4.00 1.00 The user can over: WOCV N/A 0.499 N/A N/A N/A N/A Plate N/A N/A 43	N/A N/A N/A N/A N/A N/A estrictor Plate, or R N/A N/A N/A N/A fet (relative to basin feet H:V feet H:V feet M/A 1.671 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin b feet H:V feet %, grate open area % ectangular Orifice) ft (distance below ba inches inches bottom at Stage = //P hydrographs anc 2 Year 1.19 1.422 1.422 0.6 0.03 2.3.5 0.9 N/A Plate N/A N/A 62	ottom at Stage = 0 f Gr Ov a/total area C sin bottom at Stage Half-Cent 0 ft) 1.882 1.882 1.882 1.882 1.882 1.882 1.882 1.1 0.20 30.8 1.1 0.3 Plate N/A 65	t) Height of Grat Overflow W ate Open Area / 10 verflow Grate Open Nerflow Grate Open Overflow Grate Open Ca = 0 ft) O Outle ral Angle of Restrict Spillway D Stage at Basin Area at Basin Area at Basin Volume at (entering new valu 10 Year 1.75 2.257 6.0 0.33 36.0 1.2 0.2 Plate N/A 68	e Upper Edge, H _t = /eir Slope Length =)0-yr Orifice Area = Area w/o Debris = n Area w/o Debris = alculated Parameters utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = lesign Flow Depth = Top of Freeboard = Top of Freeboard = Top of Freeboard = Top of Freeboard = 10 of Freeboard = 11.7 0.64 44.0 1.3 0.1 Plate N/A 70	Zone 3 Weir 7.78 5.15 46.99 28.86 28.86 28.86 s for Outlet Pipe w/ Zone 3 Restrictor 0.61 0.29 1.05 Calculated Parame 0.91 10.43 0.79 5.22 drographs table (CC 50 Year 2.25 3.084 3.084 15.1 0.83 50.5 5.4 0.4 Overflow Weir 1 0.1 N/A 69	Not Selected N/A N/A N/A N/A N/A N/A N/A Flow Restriction Pl Not Selected N/A N/A N/A N/A N/A ters for Spillway feet feet acres acre-ft cumns W through A 100 Year 2.52 3.543 3.543 19.7 1.08 58.9 8.8 0.4 Outlet Plate 1 0.3 N/A 68	feet feet ft ² ft ² ft ² feet radians 500 Year 3.14 4.535 4.535 27.9 1.53 75.0 9.3 0.3 0.3 Outlet Plate 1 0.3 N/A 65



Outflow Hydrograph Workbook Filename: Pond BJD-K Outlfow hydrographs

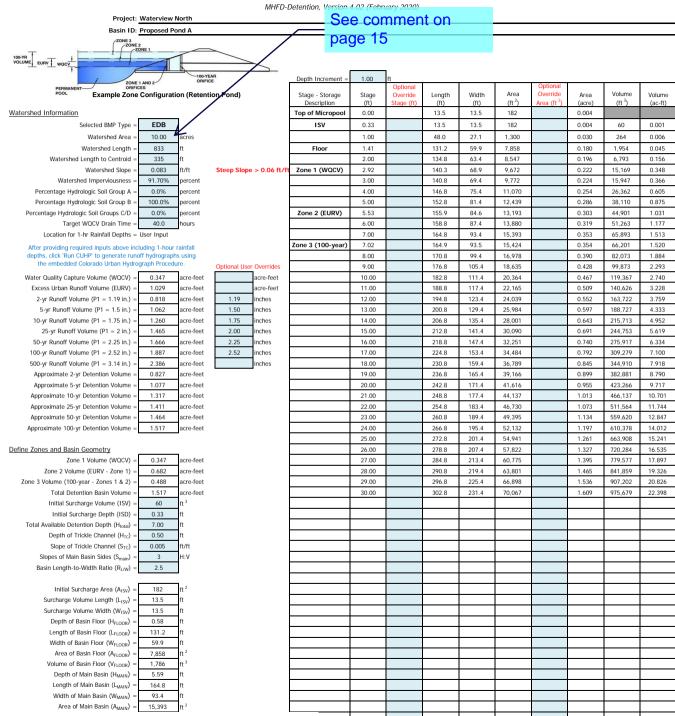
[SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
ne Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cf
.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ľ	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.03	1.01
	0:15:00	0.00	0.00	2.79	4.55	5.63	3.77	4.69	4.59	6.52
	0:20:00	0.00	0.00	9.77	12.77	15.19	9.41	10.92	11.72	15.36
	0:25:00	0.00	0.00	20.46	27.07	32.62	20.07	23.17	24.69	32.78
-	0:30:00	0.00	0.00	23.52	30.82	36.02	40.66	46.85	51.89	66.59
-	0:35:00	0.00	0.00	21.11	27.28	31.74	44.01	50.48	58.91	75.01
ŀ	0:40:00	0.00	0.00	18.32	23.21	27.04	41.01	46.93	54.64	69.46
ŀ	0:50:00	0.00	0.00	15.12 12.55	19.59 16.70	23.06 19.35	35.54 31.24	40.67 35.74	48.72 42.62	61.92 54.13
ŀ	0:55:00	0.00	0.00	10.79	14.34	16.81	25.89	29.63	36.24	46.07
ľ	1:00:00	0.00	0.00	9.57	12.66	15.05	22.08	25.29	31.77	40.42
	1:05:00	0.00	0.00	8.51	11.22	13.48	19.30	22.12	28.59	36.37
	1:10:00	0.00	0.00	7.04	9.85	11.97	16.19	18.54	23.24	29.59
	1:15:00	0.00	0.00	5.74	8.32	10.66	13.47	15.40	18.62	23.74
-	1:20:00	0.00	0.00	4.81	6.99	9.18	10.70	12.23	14.02	17.85
-	1:25:00	0.00	0.00	4.32	6.27	7.90	8.64	9.88	10.53	13.43
	1:30:00 1:35:00	0.00	0.00	4.07	5.88	7.06	7.15	8.16	8.41	10.72
-	1:40:00	0.00	0.00	3.93 3.85	5.61 5.03	6.49 6.07	6.18 5.55	7.03 6.29	7.11 6.23	9.07 7.94
-	1:45:00	0.00	0.00	3.78	4.57	5.78	5.11	5.79	5.63	7.17
F	1:50:00	0.00	0.00	3.73	4.25	5.58	4.83	5.46	5.22	6.64
	1:55:00	0.00	0.00	3.23	4.00	5.28	4.63	5.22	4.93	6.26
	2:00:00	0.00	0.00	2.83	3.70	4.77	4.50	5.07	4.76	6.06
	2:05:00	0.00	0.00	2.09	2.72	3.48	3.31	3.73	3.52	4.47
	2:10:00	0.00	0.00	1.49	1.94	2.47	2.36	2.65	2.51	3.19
	2:15:00	0.00	0.00	1.06	1.37	1.75	1.68	1.89	1.80	2.28
-	2:20:00	0.00	0.00	0.74	0.95	1.23	1.18	1.32	1.27	1.61
	2:25:00	0.00	0.00	0.50	0.63	0.84	0.80	0.90	0.87	1.10
-	2:30:00 2:35:00	0.00	0.00	0.33	0.43	0.57	0.55	0.62	0.60	0.76
-	2:40:00	0.00	0.00	0.20	0.28	0.36	0.36	0.41	0.39	0.49
ŀ	2:45:00	0.00	0.00	0.04	0.16	0.20	0.21	0.24	0.23	0.29
ŀ	2:50:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
ľ	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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ľ	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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t t	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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ļ	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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ŀ	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L	5:55:00 6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MHFD-Detention, Version 4.02 (February 2020) Summary Stage-Area-Volume-Discharge Relationships

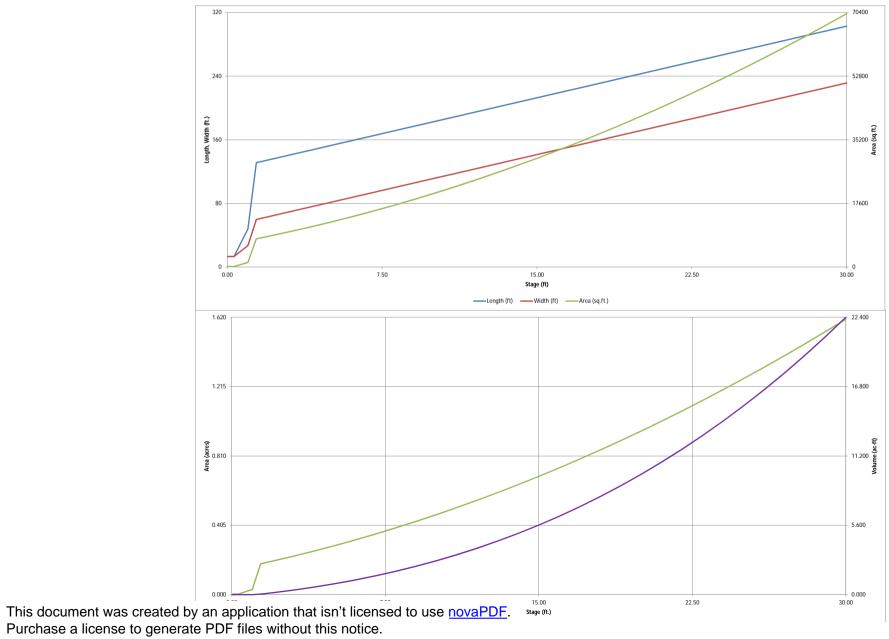
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ²]	Area [acres]	Volume [ft ³]	Volume [ac-ft]	Total Outflow [cfs]	
Top of Micrpool	0.00	163	0.004	0	0.000	0.00	For best results, include the
ISV	0.40	163	0.004	65	0.001	0.05	stages of all grade slope
151	0.60	163	0.004	98	0.002	0.06	changes (e.g. ISV and Floor
	1.20	3,150	0.072	552	0.013	0.08	from the S-A-V table on Sheet 'Basin'.
Floor	1.73	17,358	0.398	5,483	0.126	0.10	Sheet Dasin.
	2.00	17,809	0.409	10,231	0.235	0.10	Also include the inverts of a
	2.40	18,488	0.424	17,490	0.402	0.24	outlets (e.g. vertical orifice,
Zone 1	2.63	18,883	0.433	21,787	0.500	0.28	overflow grate, and spillway where applicable).
	3.00	19,527	0.448	28,893 40,927	0.663	0.33	
	3.60	20,592 21,316	0.473	40,927	0.940	0.55	-
	4.00	22,800	0.523	66,952	1.537	0.97	-
Zone 2	5.06	23,292	0.535	72,944	1.675	1.03	-
Lond L	5.40	23,943	0.550	80,974	1.859	1.11	
	6.00	25,112	0.576	95,689	2.197	1.23	1
Zone 3	6.53	26,166	0.601	109,276	2.509	1.33	
	6.60	26,306	0.604	111,113	2.551	1.84	
	7.20	27,527	0.632	127,261	2.922	8.82	
	7.80	28,773	0.661	144,150	3.309	9.12	4
	8.40	30,046	0.690	161,795	3.714	9.40	_
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POND DESIGN & ANALYSIS Proposed Pond A

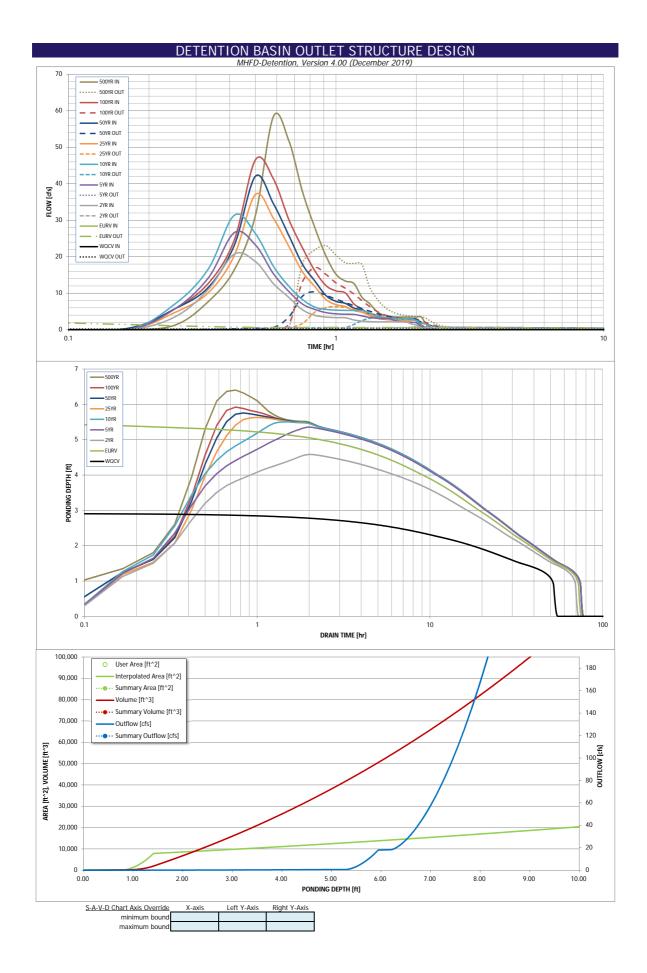


MHFD-Detention, Version 4.02 (February 2020)



			D-Detention, Vers	• • • •) ====)				
	Waterview North								
ZONE 3	Proposed Pond A								
ZONE 2 ZONE 1				Estimated	Estimated Volume (ac-ft)	Outlot Tupo			
OU-YR EURY WQCY			Zone 1 (WQCV)	Stage (ft) 2.92	0.347	Outlet Type Orifice Plate			
T T Mach									
ZONE 1 AND 2	0RIFICE		Zone 2 (EURV)	5.53	0.682	Orifice Plate			
PERMANENT ORIFICES POOL Example Zone	Configuration (Re	tention Pond)	Zone 3 (100-year)		0.488	Weir&Pipe (Restrict)			
			4D)	Total (all zones)	1.517		Coloulated Daramai	ters for Underdrain	
ser Input: Orifice at Underdrain Outlet (typically Underdrain Orifice Invert Depth =		ft (distance below		surfaco)	Under	drain Orifice Area =		ft ²	
Underdrain Orifice Diameter =		inches	the fill alon media	surrace)		n Orifice Centroid =		feet	
		linonos			ondorardi			1001	
ser Input: Orifice Plate with one or more orifice	s or Elliptical Slot \	Veir (typically used	to drain WQCV and	d/or EURV in a sedir	mentation BMP)		Calculated Paramet	ters for Plate	
Invert of Lowest Orifice =	0.00	ft (relative to basin	n bottom at Stage =	= 0 ft)	WQ Orif	ice Area per Row =	N/A	ft ²	
Depth at top of Zone using Orifice Plate =	5.30		bottom at Stage =	= 0 ft)		iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches			•	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	inches			E	Iliptical Slot Area =	N/A	ft ²	
ser Input: Stage and Total Area of Each Orifice	Pow (numbered fr	om lowest to highe	.ct)						
Ser input. Stage and rotal hied of Lach Utilite	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	0.00	1.50	2.25	3.00	4.00	o (optional)	(optional)	(optional)	1
Orifice Area (sq. inches)	1.00	1.82	2.00	3.00	4.00				
									-
[Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	
Stage of Orifice Centroid (ft)									
Orifice Area (sq. inches)									
	1>						Coloulated Deserve		C
ser Input: Vertical Orifice (Circular or Rectangu	Not Selected	Not Selected	1				Not Selected	ters for Vertical Orif Not Selected	lice
Invert of Vertical Orifice =	N/A		ft (relative to basir	n bottom at Stage =	0 ft) Ve	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A		h bottom at Stage =		I Orifice Centroid =	N/A	N/A	feet
				·					
Vertical Orifice Diameter =	N/A	N/A	inches						
Vertical Orifice Diameter =	N/A	N/A	inches						
Vertical Orifice Diameter =	N/A	N/A	inches						
				al Weir <u>(</u> and No Out	let Pipe)		Calculated Parame	ters for Overflow W	<u>'eir</u>
ser Input: Overflow Weir (Dropbox with Flat or	Sloped Grate and Zone 3 Weir	Outlet Pipe OR Rec Not Selected	tangular/Trapezoida				Zone 3 Weir	Not Selected	
ser Input: Overflow Weir (Dropbox with Flat or Overflow Weir Front Edge Height, Ho =	Sloped Grate and Zone 3 Weir 5.30	Outlet Pipe OR Rec Not Selected N/A	tangular/Trapezoida ft (relative to basin b	<u>al Weir (and No Out</u> bottom at Stage = 0 f	t) Height of Grat	e Upper Edge, H _t =	Zone 3 Weir 6.18	Not Selected N/A	feet
ser Input: Overflow Weir (Dropbox with Flat or Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length =	Sloped Grate and Zone 3 Weir 5.30 8.00	Outlet Pipe OR Rect Not Selected N/A N/A	tangular/Trapezoida ft (relative to basin t feet	bottom at Stage = 0 f	t) Height of Grat Overflow V	e Upper Edge, H _t = /eir Slope Length =	Zone 3 Weir 6.18 3.61	Not Selected N/A N/A	
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FYI: Final pond design will need this This document was created by to bepat 40hrhat isn't licensed to use novaPDF. Purchase a license to generate PDF files without this notice.



DETENTION BASIN OUTLET STRUCTURE DESIGN Outflow Hydrograph Workbook Filename:

r		verride the calcu	-						_	
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.04	1.26
	0:15:00	0.00	0.00	3.51	5.71	7.05	4.73	5.73	5.73	7.72
	0:20:00	0.00	0.00	11.06	14.20	16.66	10.14	11.60	12.72	16.37
	0:30:00	0.00	0.00	20.69 18.68	26.59 23.22	31.35 26.33	20.31 37.05	23.11 42.03	24.56 46.54	31.32 58.37
	0:35:00	0.00	0.00	12.65	15.39	17.42	30.57	34.59	41.36	51.78
	0:40:00	0.00	0.00	8.85	10.46	11.91	22.84	25.81	30.18	37.78
	0:45:00	0.00	0.00	5.45	7.02	8.27	15.84	17.90	22.39	28.02
	0:50:00	0.00	0.00	3.95	5.57	6.21	11.84	13.38	16.18	20.26
	0:55:00	0.00	0.00	3.47	4.69	5.57	8.31	9.40	12.13	15.22
	1:00:00	0.00	0.00	3.31	4.37	5.36	6.87	7.78	10.63	13.36
	1:05:00	0.00	0.00	3.28	4.25	5.29	6.37	7.22	10.08	12.67
	1:10:00	0.00	0.00	2.67	4.19 3.79	5.28 5.28	5.25 4.79	5.96 5.43	7.07	8.92 7.21
	1:20:00	0.00	0.00	2.24	3.36	4.62	3.96	4.49	4.03	5.09
	1:25:00	0.00	0.00	2.24	3.16	3.75	3.56	4.47	3.19	4.03
	1:30:00	0.00	0.00	2.15	3.07	3.34	2.98	3.37	2.90	3.66
	1:35:00	0.00	0.00	2.15	3.03	3.14	2.70	3.06	2.78	3.50
ļ	1:40:00	0.00	0.00	2.15	2.48	3.06	2.60	2.94	2.76	3.48
	1:45:00	0.00	0.00	2.15	2.22	3.05	2.55	2.89	2.76	3.48
	1:50:00	0.00	0.00	2.15	2.11	3.05	2.54	2.88	2.76	3.48
	1:55:00 2:00:00	0.00	0.00	1.56	2.04	2.86	2.54	2.88	2.76	3.48
	2:00:00	0.00	0.00	1.28	1.88	2.42	2.54 1.15	2.88	2.76	3.48 1.58
	2:10:00	0.00	0.00	0.22	0.36	0.45	0.49	0.56	0.53	0.67
	2:15:00	0.00	0.00	0.08	0.14	0.16	0.19	0.22	0.21	0.26
	2:20:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.04
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00 2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00 3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ì	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00 4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00 4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00 5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00 5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00 5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ²]	Area [acres]	Volume [ft ³]	Volume [ac-ft]	Outflow [cfs]	
							For best results, include the
							stages of all grade slope
				1			changes (e.g. ISV and Floor
							from the S-A-V table on
							Sheet 'Basin'.
				1			Also include the inverts of a
				1			outlets (e.g. vertical orifice.
							overflow grate, and spillway where applicable).
							where applicable).
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POND DESIGN & ANALYSIS

Proposed Pond JCD-D

Area (acre) Volume (ft 3) Volume (ac-ft)

0.017

0.017 303 0.007 0.041 805

1.672 46,527 1.068

1.704 76,672 1.760 1.730 101,353 2.327

1.784 152,625 3.504

1.865 232,083 5.328 1.948 315,117 7.234

1.957 324,472 7.449 2.032 401,799 9.224

2.117 490,356 11.257

2.119 492,201 11.299 2.206 586,395 13.462

2.296 684,453 15.713 2.387 786,447 18.054 2.480 892,450 20.488

2.575 1,002,532 23.015

2.671 1,116,767 25.637 2.768 1,235,226 28.357

2.868 1,357,980 31.175

2.969 1,485,103 34.093

3.072 1,616,666 37.114 3.176 1,752,741 40.237

3.282 1,893,401 43.466

3.390 2,038,716 46.802

3.499 2,188,759 50.247

3.610 2,343,603 53.802 3.723 2,503,318 57.468

3.837 2,667,978 61.248

3.953 2,837,654 65.144 4.071 3,012,418 69.156 4.190 3,192,342 73.286

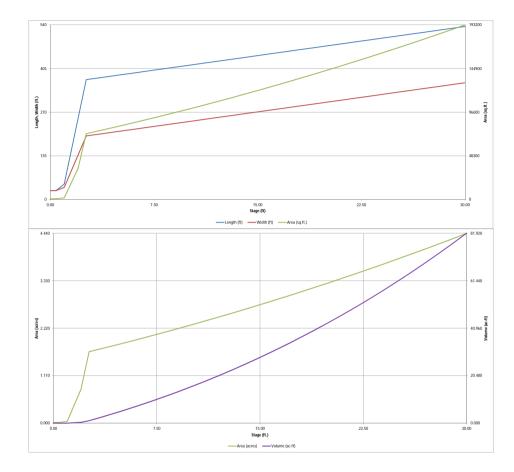
4.311 3,377,498 77.537 4.434 3,567,958 81.909

0.018 0.792 15,564 0.357

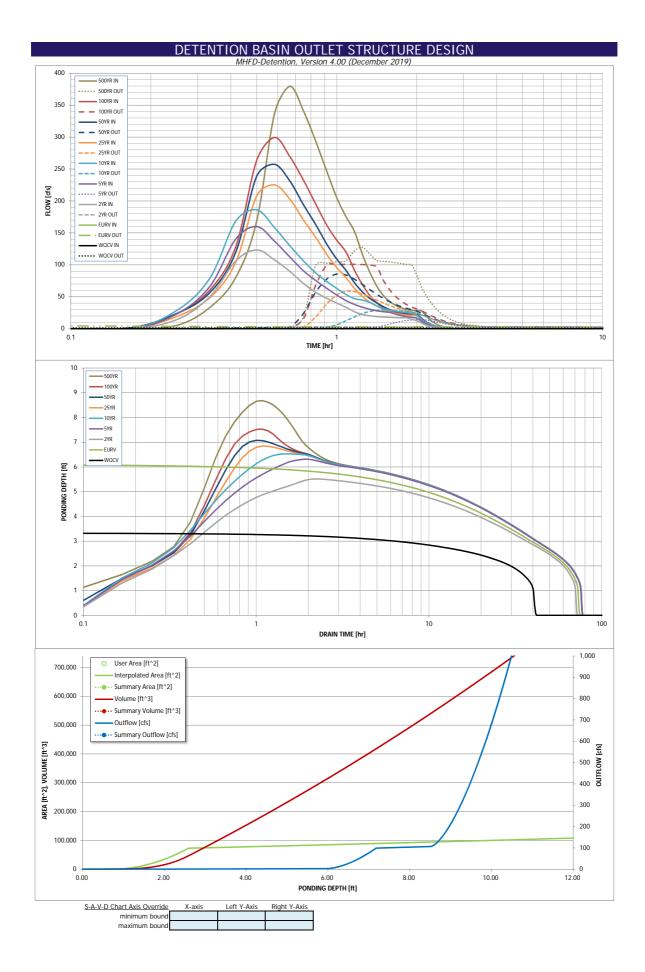
				MHFD	Detention, Version	4.02 (Febri	uary 2020)		LULK		
	Waterview I										
Basin ID:	Pond JCD-D										
	2 ONE 1		_								
		1	_								
		100-YEA	R		Depth Increment =	1.00	n				
		on (Potontic	n Rond)		Stage - Storage	Stage	Optional	Length	Width	Area	Г
	Conngurati	on (Retentio	on Fond)		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft ²)	
Watershed Information	-	-			Top of Micropool	0.00		27.5	27.5	757	
Selected BMP Type =	EDB				ISV	0.40		27.5	27.5	757	
Watershed Area =	81.81	acres				1.00		47.8	37.5	1,794	
Watershed Length = Watershed Length to Centroid =	2,950	ft er			Floor	2.00		250.8 370.6	137.5 196.5	34,490 72.824	
Watershed Length to Centrold = Watershed Slope =	0.040	n/n			FIGO	3.00		373.0	198.0	74,226	t
Watershed Imperviousness =	81.80%	percent			Zone 1 (WQCV)	3.33		375.0	201.0	75,362	t
Percentage Hydrologic Soil Group A =	0.0%	percent				4.00		379.0	205.0	77,694	
Percentage Hydrologic Soil Group B =	100.0%	percent				5.00		385.0	211.0	81,234	
Percentage Hydrologic Soil Groups C/D = Target WOCV Drain Time =	0.0%	percent hours			7 0 (51010	6.00		391.0 391.7	217.0	84,846 85.248	
Location for 1-hr Rainfall Depths =		nours			Zone 2 (EURV)	7.00		391.7	217.6	85,248	t
After providing required inputs above in		rainfall			Zone 3 (100-year)	7.98		402.9	228.9	92,210	t
depths, click 'Run CUHP' to generate run	off hydrograph	is using				8.00		403.0	229.0	92,286	
the embedded Colorado Urban Hydro		-	Optional User			9.00		409.0	235.0	96,114	
Water Quality Capture Volume (WQCV) = Excess Urban Runoff Volume (EURV) =	2.317	acre-feet acre-feet		acre-feet acre-feet		10.00		415.0 421.0	241.0 247.0	100,014	
2-vr Runoff Volume (P1 = 1.19 in.) =	6.656	acre-feet	1 19	inches		12.00		421.0	247.0	103,986	┢
5-yr Runoff Volume (P1 = 1.5 in.) =	8.777	acre-feet	1.50	inches		13.00		433.0	259.0	112,147	t
10-yr Runoff Volume (P1 = 1.75 in.) =	10.527	acre-feet	1.75	inches		14.00		439.0	265.0	116,335	
25-yr Runoff Volume (P1 = 2 in.) =	12.444	acre-feet	2.00	inches		15.00		445.0	271.0	120,595	
50-yr Runoff Volume (P1 = 2.25 in.) = 100-yr Runoff Volume (P1 = 2.52 in.) =	14.246 16.293	acre-feet acre-feet	2.25	inches inches		16.00 17.00		451.0 457.0	277.0 283.0	124,927 129,331	
500-yr Runoff Volume (P1 = 2.52 in.) =	20.810	acre-feet	2.52	inches		18.00		457.0	283.0	129,331	┢
Approximate 2-yr Detention Volume =	5.909	acre-feet				19.00		469.0	295.0	138,355	t
Approximate 5-yr Detention Volume =	7.772	acre-feet				20.00		475.0	301.0	142,975	
Approximate 10-yr Detention Volume =	9.624	acre-feet				21.00		481.0	307.0	147,667	
Approximate 25-yr Detention Volume =	10.312 10.710	acre-feet acre-feet				22.00 23.00		487.0 493.0	313.0 319.0	152,431 157,268	
Approximate 50-yr Detention Volume = Approximate 100-yr Detention Volume =	11.254	acre-feet				23.00		493.0	319.0	162,176	╋
Approximate roo-ji beterinan totane -	11.2.54	and the second				25.00		505.0	331.0	167,156	t
Define Zones and Basin Geometry		_				26.00		511.0	337.0	172,208	
Zone 1 Volume (WQCV) =	2.317	acre-feet				27.00		517.0	343.0	177,332	
Zone 2 Volume (EURV - Zone 1) = Zone 3 Volume (100-year - Zones 1 & 2) =	5.124 3.812	acre-feet acre-feet				28.00 29.00		523.0 529.0	349.0	182,528 187,796	
Total Detention Basin Volume =	3.812	acre-feet				30.00		529.0	355.0 361.0	193,136	┝
Initial Surcharge Volume (ISV) =	303	ft 3									t
Initial Surcharge Depth (ISD) =	0.40	π									
Total Available Detention Depth (H _{total}) =	8.00	π									
Depth of Trickle Channel (H_{TC}) = Slope of Trickle Channel (S_{TC}) =	0.50	ft n/n									
Slopes of Main Basin Sides (Smain) =	3	H:V									┢
Basin Length-to-Width Ratio (RL/W) =	2										T
		-									
Initial Surcharge Area (A _{ISV}) =	757	π ²									
Surcharge Volume Length (L_{ISV}) = Surcharge Volume Width (W_{ISV}) =	27.5	n n									
Depth of Basin Floor (H _{FLOOR}) =	1.69	n									t
Length of Basin Floor (L _{FLOOR}) =	370.6	π									t
Width of Basin Floor (W_{FLOOR}) =	196.5	π									
Area of Basin Floor (A _{FLOOR}) = Volume of Basin Floor (V _{FLOOR}) =	72,824 45,633	n² n³									
Volume of Basin Floor (V _{FLOOR}) = Depth of Main Basin (H _{MAIN}) =	45,633 5.41	π." π							<u> </u>		t
Length of Main Basin (LMAIN) =	403.0	π									t
Width of Main Basin (W_{MAIN}) =	229.0	π									ſ
Area of Main Basin (A _{MAIN}) = Volume of Main Basin (V _{MAIN}) =	92,286 445.586	nt 2 nt 3									+
Volume of Main Basin (V _{MAIN}) = Calculated Total Basin Volume (V _{INTAL}) =	445,586 11.292	ft" acre-feet									╉
	11.272										t
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		MHF	D-Detention, Vers	sion 4.02 (Februar	y 2020)				
	Waterview North								
Basin ID:	Pond JCD-D								
ZONE 2 ZONE 2 ZONE 1	\frown			Estimated	Estimated				
100-YR				Stage (ft)	Volume (ac-ft)	Outlet Type	1		
			Zone 1 (WQCV)	3.33	2.317	Orifice Plate			
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.11	5.124	Orifice Plate			
PERMANENT ORIFICES			Zone 3 (100-year)	7.98	3.812	Weir&Pipe (Restrict)			
Example Zone	Configuration (Re	tention Pond)		Total (all zones)	11.254		-		
ser Input: Orifice at Underdrain Outlet (typically	y used to drain WQ	CV in a Filtration BN	<u>//P)</u>				Calculated Parame	eters for Underdrain	
Underdrain Orifice Invert Depth =	N/A	ft (distance below	the filtration media	surface)		drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrai	n Orifice Centroid =	N/A	feet	
		A/-1/11							
ser Input: Orifice Plate with one or more orifice Invert of Lowest Orifice =	0.00					fice Area per Row =	Calculated Parame N/A	ft ²	
Depth at top of Zone using Orifice Plate =	6.00		<pre>bottom at Stage = bottom at Stage =</pre>			liptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	- bottom at stage -	010		tical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	inches				Elliptical Slot Area =	N/A	ft ²	
								_	
ser Input: Stage and Total Area of Each Orifice	Row (numbered fr	om lowest to highe	<u>st)</u>						-
	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	l
Stage of Orifice Centroid (ft)	0.00	1.50	2.25	3.00	3.75	4.50	5.25		
Orifice Area (sq. inches)	7.20	7.20	7.20	7.20	7.20	7.20	10.00		J
					[T		T	1
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	4
Stage of Orifice Centroid (ft)									1
Orifice Area (sq. inches)									J
ser Input: Vertical Orifice (Circular or Rectangu	llar)						Calculated Parame	eters for Vertical Orif	fico
ser input. Vertical office (offedial of Rectange	Not Selected	Not Selected					Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basir	n bottom at Stage =	0 ft) Ve	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A		n bottom at Stage =		al Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				-	•	4
ser Input: Overflow Weir (Dropbox with Flat or	Sloped Grate and	Outlet Pipe OR Rect	tangular/Trapezoida	al Weir (and No Out	let Pipe)		Calculated Parame	eters for Overflow W	leir
	Zone 3 Weir	Not Selected					Zone 3 Weir	Not Selected]
Overflow Weir Front Edge Height, Ho =	Zone 3 Weir 6.00	Not Selected N/A	ft (relative to basin b	al Weir (and No Out	t) Height of Grat	te Upper Edge, H _t =	Zone 3 Weir 7.00	Not Selected N/A	feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length =	Zone 3 Weir 6.00 16.00	Not Selected N/A N/A	ft (relative to basin b	pottom at Stage = 0 f	t) Height of Grat Overflow V	Veir Slope Length =	Zone 3 Weir 7.00 4.12	Not Selected N/A N/A]
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	Zone 3 Weir 6.00 16.00 4.00	Not Selected N/A N/A N/A	ft (relative to basin b feet H:V	pottom at Stage = 0 f Gi	t) Height of Grat Overflow V rate Open Area / 1	Veir Slope Length = 00-yr Orifice Area =	Zone 3 Weir 7.00 4.12 7.42	Not Selected N/A N/A N/A	feet feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	Zone 3 Weir 6.00 16.00 4.00 4.00	Not Selected N/A N/A N/A N/A	ft (relative to basin t feet H:V feet	oottom at Stage = 0 f Gi O [.]	t) Height of Grat Overflow V rate Open Area / 1 verflow Grate Oper	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris =	Zone 3 Weir 7.00 4.12 7.42 52.78	Not Selected N/A N/A N/A N/A	feet feet ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % =	Zone 3 Weir 6.00 16.00 4.00 4.00 80%	Not Selected N/A N/A N/A N/A N/A	ft (relative to basin t feet H:V feet %, grate open area	oottom at Stage = 0 f Gi O [.]	t) Height of Grat Overflow V rate Open Area / 1 verflow Grate Oper	Veir Slope Length = 00-yr Orifice Area =	Zone 3 Weir 7.00 4.12 7.42	Not Selected N/A N/A N/A	feet feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	Zone 3 Weir 6.00 16.00 4.00 4.00	Not Selected N/A N/A N/A N/A	ft (relative to basin t feet H:V feet	oottom at Stage = 0 f Gi O [.]	t) Height of Grat Overflow V rate Open Area / 1 verflow Grate Oper	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris =	Zone 3 Weir 7.00 4.12 7.42 52.78	Not Selected N/A N/A N/A N/A	feet feet ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % =	Zone 3 Weir 6.00 16.00 4.00 4.00 80% 0%	Not Selected N/A N/A N/A N/A N/A N/A	ft (relative to basin t feet H:V feet %, grate open are %	oottom at Stage = 0 f Gi O [.]	t) Height of Grai Overflow V rate Open Area / 1 verflow Grate Oper Overflow Grate Oper	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris =	Zone 3 Weir 7.00 4.12 7.42 52.78 52.78	Not Selected N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % =	Zone 3 Weir 6.00 16.00 4.00 4.00 80% 0%	Not Selected N/A N/A N/A N/A N/A N/A	ft (relative to basin t feet H:V feet %, grate open are %	oottom at Stage = 0 f Gi O [.]	t) Height of Grai Overflow V rate Open Area / 1 verflow Grate Oper Overflow Grate Oper	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris = en Area w/ Debris =	Zone 3 Weir 7.00 4.12 7.42 52.78 52.78	Not Selected N/A N/A N/A N/A N/A CFlow Restriction Pir	feet feet ft ² ft ²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % =	Zone 3 Weir 6.00 16.00 4.00 4.00 80% 0% (Circular Orifice, Re	Not Selected N/A N/A N/A N/A N/A N/A estrictor Plate, or Re	ft (relative to basin t feet H:V feet %, grate open are % ectangular Orifice)	oottom at Stage = 0 f Gi O [.]	t) Height of Grat Overflow V rate Open Area / 1 verflow Grate Oper Overflow Grate Oper <u>C</u>	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris = en Area w/ Debris =	Zone 3 Weir 7.00 4.12 7.42 52.78 52.78 s for Outlet Pipe w/	Not Selected N/A N/A N/A N/A N/A CFlow Restriction Pir	feet feet ft ² ft ²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = Ser Input: Outlet Pipe w/ Flow Restriction Plate	Zone 3 Weir 6.00 16.00 4.00 4.00 80% 0% (Circular Orifice, Re Zone 3 Restrictor	Not Selected N/A N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected	ft (relative to basin t feet H:V feet %, grate open are % ectangular Orifice)	oottom at Stage = 0 f Gi O a/total area (t) Height of Grat Overflow V rate Open Area / 1 verflow Grate Oper Overflow Grate Oper <u>C</u> = 0 ft) C	Veir Slope Length = 00-yr Orifice Area = n Area w/o Debris = en Area w/ Debris = alculated Parameter	Zone 3 Weir 7.00 4.12 7.42 52.78 52.78 s for Outlet Pipe w/ Zone 3 Restrictor	Not Selected N/A N/A N/A N/A N/A Flow Restriction Pli Not Selected	feet feet ft ² ft ² <u>ate</u>
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Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Open Area % = Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert =	Zone 3 Weir 6.00 16.00 4.00 80% 0% (Circular Orifice, R Zone 3 Restrictor 2.50 42.00 29.10	Not Selected N/A N/A N/A N/A N/A estrictor Plate, or R Not Selected N/A	ft (relative to basin t feet H:V feet %, grate open are % ectangular Orifice) ft (distance below ba inches	oottom at Stage = 0 f Gi a/total area (asin bottom at Stage	t) Height of Gran Overflow V rate Open Area / 1 verflow Grate Oper Overflow Grate Oper <u>C</u> = 0 ft) C	Veir Slope Length = 00-yr Orifice Area = h Area w/o Debris = en Area w/ Debris = alculated Parameter Dutlet Orifice Area = et Orifice Centroid =	Zone 3 Weir 7.00 4.12 7.42 52.78 52.78 s for Outlet Pipe w/ Zone 3 Restrictor 7.11 1.36 1.97	Not Selected N/A N/A N/A N/A N/A N/A V/A V/A V/A N/A N/A N/A N/A N/A	feet feet ft ² ft ² ft ²
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DETENTION BASIN OUTLET STRUCTURE DESIGN Outflow Hydrograph Workbook Filename:

[SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	t in a separate pr CUHP	CUHP	CUHP
ime Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]		25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	
	0:00:00									
5.00 min	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
·	0:15:00	0.00	0.00	0.00	23.04	0.00 28.48	19.10	1.59 23.80	0.16 23.23	5.10 33.29
	0:20:00	0.00	0.00	50.26	66.23	79.11	48.68	56.50	60.59	79.89
-	0:25:00	0.00	0.00	105.91	140.18	168.04	103.66	119.29	127.90	168.58
	0:30:00	0.00	0.00	123.28	159.84	186.20	207.81	238.54	263.41	336.48
	0:35:00	0.00	0.00	107.68	137.06	158.38	225.16	257.38	299.46	379.56
	0:40:00	0.00	0.00	89.60	112.13	129.83	202.69	231.19	269.44	341.03
	0:45:00	0.00	0.00	70.76	90.54	106.18	170.19	194.04	232.50	293.96
·	0:50:00	0.00	0.00	56.99 47.78	75.53	87.41	143.28	163.24	195.41 162.49	247.01
	1:00:00	0.00	0.00	47.78	63.30 52.78	74.13 63.03	116.43 95.75	132.70 109.25	138.74	205.52 175.60
	1:05:00	0.00	0.00	33.67	44.13	53.67	80.04	91.39	138.74	175.60
ľ	1:10:00	0.00	0.00	26.55	37.95	47.15	62.99	71.96	91.54	116.20
İ	1:15:00	0.00	0.00	22.31	33.70	44.73	50.35	57.60	68.88	87.99
[1:20:00	0.00	0.00	20.20	30.32	41.00	41.34	47.29	51.83	66.34
[1:25:00	0.00	0.00	18.91	28.03	35.68	35.34	40.40	40.27	51.59
ļ	1:30:00	0.00	0.00	18.23	26.54	31.75	30.05	34.31	33.19	42.54
ļ	1:35:00	0.00	0.00	17.75	25.57	29.13	26.21	29.89	28.58	36.62
ŀ	1:40:00	0.00	0.00	17.40	22.78	27.34	23.87	27.20	25.54	32.72
ł	1:45:00	0.00	0.00	17.17 17.07	20.42 18.85	26.13 25.28	22.25 21.23	25.33 24.16	23.52 22.37	30.14 28.66
·	1:55:00	0.00	0.00	14.71	17.77	23.20	20.66	23.49	21.97	28.12
·	2:00:00	0.00	0.00	12.62	16.54	21.45	20.30	23.08	21.79	27.88
-	2:05:00	0.00	0.00	8.89	11.73	15.12	14.57	16.56	15.73	20.13
	2:10:00	0.00	0.00	5.81	7.66	9.98	9.59	10.90	10.40	13.30
	2:15:00	0.00	0.00	3.79	4.96	6.55	6.36	7.22	6.89	8.81
	2:20:00	0.00	0.00	2.36	3.09	4.13	4.03	4.58	4.37	5.58
	2:25:00	0.00	0.00	1.39	1.92	2.53	2.52	2.87	2.73	3.49
	2:30:00	0.00	0.00	0.73	1.12	1.42	1.48	1.68	1.61	2.05
-	2:35:00	0.00	0.00	0.31	0.53	0.64	0.72	0.81	0.77	0.99
-	2:40:00 2:45:00	0.00	0.00	0.10	0.16	0.18	0.22	0.25	0.24	0.30
ŀ	2:43:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ľ	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	3:35:00 3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ł	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ľ	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	4:15:00 4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ł	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
į	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	4:40:00 4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ľ	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	5:00:00 5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ł	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	5:25:00 5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ł	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
į	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-	5:55:00 6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ²]	Area [acres]	Volume [ft ³]	Volume [ac-ft]	Outflow [cfs]	
							For best results, include the
							stages of all grade slope
				1			changes (e.g. ISV and Floor
							from the S-A-V table on
							Sheet 'Basin'.
				1			Also include the inverts of a
				1			outlets (e.g. vertical orifice.
							overflow grate, and spillway where applicable).
							where applicable).
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APPENDIX D

CULVERT ANALYSES

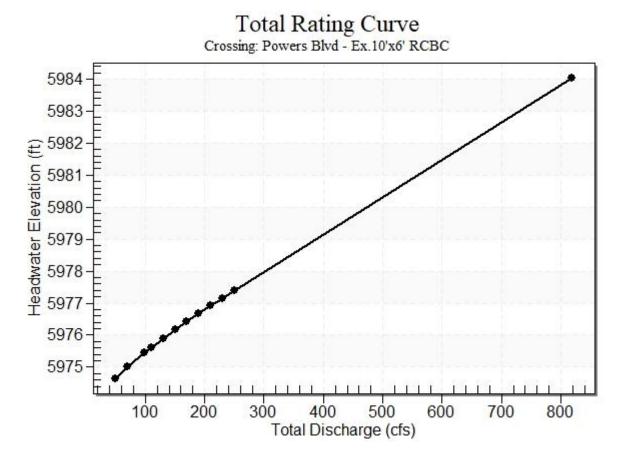
HY-8 Culvert Analysis Report Ex. 10x6 RCBC Xing under Powers Blvd.

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow Minimum Flow: 50 cfs Design Flow: 98 cfs Maximum Flow: 250 cfs

Flows at Crossing: Powers Blvd - Ex.10'x6' RCBC

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5974.65	50.00	50.00	0.00	1
5975.00	70.00	70.00	0.00	1
5975.44	98.00	98.00	0.00	1
5975.62	110.00	110.00	0.00	1
5975.90	130.00	130.00	0.00	1
5976.16	150.00	150.00	0.00	1
5976.43	170.00	170.00	0.00	1
5976.68	190.00	190.00	0.00	1
5976.92	210.00	210.00	0.00	1
5977.15	230.00	230.00	0.00	1
5977.38	250.00	250.00	0.00	1
5984.00	798.03	798.03	0.00	Overtopping



Rating Curve Plot for Crossing: Powers Blvd - Ex.10'x6' RCBC

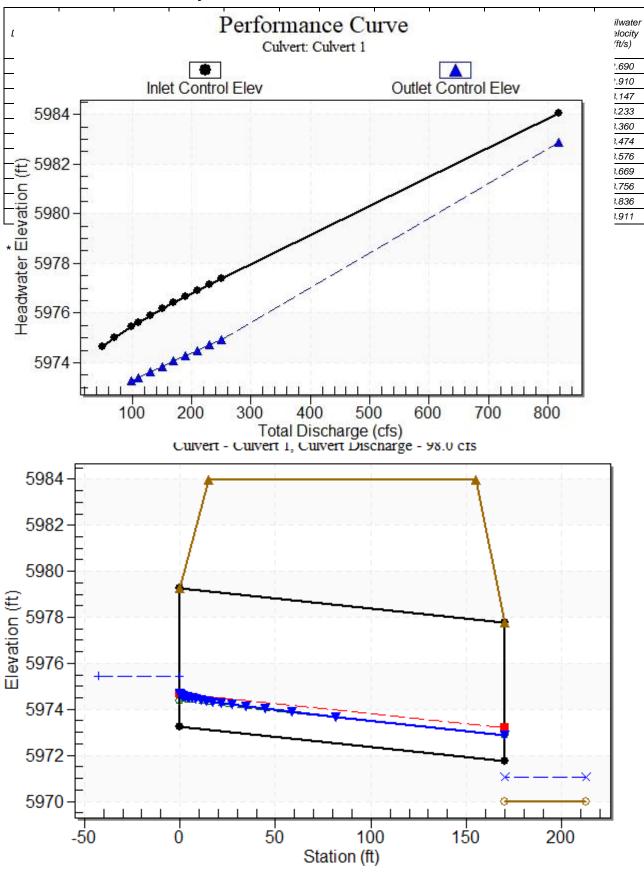
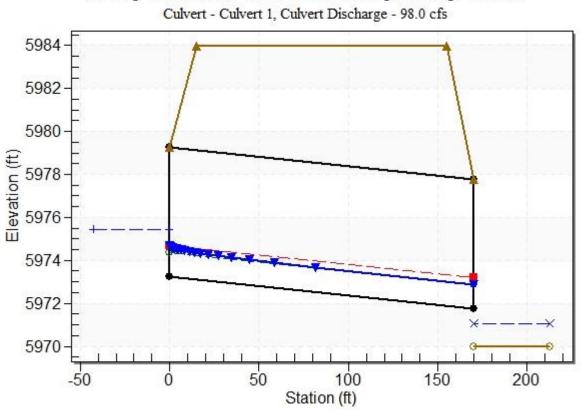


Table 2 - Culvert Summary Table: Culvert 1







Crossing - Powers Blvd - Ex.10'x6' RCBC, Design Discharge - 98.0 cfs

Site Data - Culvert 1

Site Data Option: Culvert Invert Data Inlet Station: 0.00 ft Inlet Elevation: 5973.25 ft Outlet Station: 170.00 ft Outlet Elevation: 5971.75 ft Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box Barrel Span: 10.00 ft Barrel Rise: 6.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0150 Culvert Type: Straight Inlet Configuration: Square Edge (30-75º flare) Wingwall Inlet Depression: None

Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number	Tailwater Channel Dat Ex.10'x6' RCBC	a - Powers Bl	vd -		
5970.77	0.77	2.69	0.30	0.70	Tailwatar Channel Ontion:	Irrogular Chai	anal		
5970.89	0.89	2.91	0.35	0.71					
5971.04	1.04	3.15	0.41	0.72	Channel Slope:	33			
5971.09	1.09	3.23	0.43	0.72	User Defined Channel Cross-Section:				
5971.17	1.17	3.36	0.46	0.72	Coord No	Station (ft)	Flevation		
5971.25	1.25	3.47	0.49	0.73			Lievalion		
5971.32	1.32	3.58	0.52	0.73		2.00	5074.00	0.000	
5971.38	1.38	3.67	0.54	0.73	7 7	0.00	5974.00	0.0300	
5971.44	1.44	3.76	0.57	0.74	2	112.00	5972.00	0.0300	
5971.50	1.50	3.84	0.59	0.74	- 3	147.00	5970.00	0.0250	
5971.56	1.56	3.91	0.61	0.74	4	155.00	5970.00	0.0300	
· · · · · · · · · · · · · · · · · · ·	5970.77 5970.89 5971.04 5971.09 5971.17 5971.25 5971.32 5971.38 5971.44 5971.50	Elev (ft)1	Elev (ft)1115970.770.772.695970.890.892.915971.041.043.155971.091.093.235971.171.173.365971.251.253.475971.321.323.585971.441.443.765971.501.503.84	Elev (ft)1111115970.770.772.690.305970.890.892.910.355971.041.043.150.415971.091.093.230.435971.171.173.360.465971.251.253.470.495971.321.323.580.525971.381.383.670.545971.441.443.760.575971.501.503.840.59	Elev (ft)1.7.4 (r)2.690.300.705970.770.772.690.300.705970.890.892.910.350.715971.041.043.150.410.725971.091.093.230.430.725971.171.173.360.460.725971.251.253.470.490.735971.321.323.580.520.735971.381.383.670.540.735971.441.443.760.570.745971.501.503.840.590.74	Elev (ft) Depart(n) Depart(n) Depart(n) Depart(n) Depart(n) Depart(n) Ex.10'x6' RCBC 5970.77 0.77 2.69 0.30 0.70 Tailwater Channel Option: 5970.89 0.89 2.91 0.35 0.71 Tailwater Channel Option: 5971.04 1.04 3.15 0.41 0.72 Channel Slope: 5971.09 1.09 3.23 0.43 0.72 User Defined Channel Slope: 5971.17 1.17 3.36 0.46 0.72 User Defined Channel Slope: 5971.32 1.32 3.58 0.52 0.73 (ft) Manning's n 5971.38 1.38 3.67 0.54 0.73 1 5971.50 1.50 3.84 0.59 0.74 3 5971.56 1.56 3.91 0.61 0.74 3	Elev (ft) Dop (ft) Description Ender (per) Description Ex.10'x6' RCBC 5970.77 0.77 2.69 0.30 0.70 Tailwater Channel Option: Irregular Channel 5970.77 0.89 2.91 0.35 0.71 Tailwater Channel Option: Irregular Channel 5971.04 1.04 3.15 0.41 0.72 Octoor (per) User Defined Channel Cross-Section 5971.09 1.09 3.23 0.43 0.72 Octoor No. Station (ft) 5971.25 1.25 3.47 0.49 0.73 (ft) Manning's n 5971.32 1.32 3.58 0.52 0.73 1 0.00 5971.44 1.44 3.76 0.57 0.74 1 0.00 5971.50 1.50 3.84 0.59 0.74 3 147.00	Elev (ft) Depart(e) Decar(pc) Product(pc) Product(pc) Ex.10'x6' RCBC 5970.77 0.77 2.69 0.30 0.70 Tailwater Channel Option: Irregular Channel 5970.89 0.89 2.91 0.35 0.71 Channel Slope: 0.0063 5971.04 1.04 3.15 0.41 0.72 User Defined Channel Cross-Section: 5971.17 1.17 3.36 0.46 0.72 Coord No. Station (ft) Elevation 5971.25 1.25 3.47 0.49 0.73 (ft) Manning's n Elevation 5971.32 1.32 3.58 0.52 0.73 1 0.00 5974.00 5971.44 1.44 3.76 0.57 0.74 1 0.00 5972.00 5971.50 1.50 3.84 0.59 0.74 3 147.00 5970.00	

Table 3 - Downstream Channel Rating Curve (Crossing: Powers Blvd - Ex.10'x6' RCBC)

5	205.00	5972.00	0.0300
6	330.00	5974.00	0.0000

Roadway Data for Crossing: Powers Blvd - Ex.10'x6' RCBC

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 510.00 ft

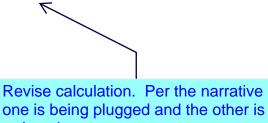
Crest Elevation: 5984.00 ft

Roadway Surface: Paved

Roadway Top Width: 140.00 ft

HY-8 Culvert Analysis Report

Ex. DUAL 42" CMP CULVERT CROSSING BRADLEY ROAD



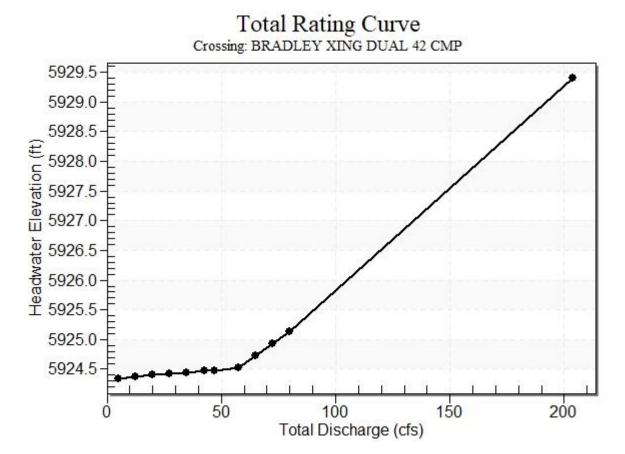
one is being plugged and the other is reduced.

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow Minimum Flow: 5 cfs Design Flow: 47 cfs Maximum Flow: 80 cfs

Table 1 - Summary of Culvert Flows at Crossing: BRADLEY XING DUAL 42 CMP

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5924.35	5.00	5.00	0.00	1
5924.38	12.50	12.50	0.00	1
5924.40	20.00	20.00	0.00	1
5924.43	27.50	27.50	0.00	1
5924.45	35.00	35.00	0.00	1
5924.47	42.50	42.50	0.00	1
5924.48	47.00	47.00	0.00	1
5924.53	57.50	57.50	0.00	1
5924.73	65.00	65.00	0.00	1
5924.93	72.50	72.50	0.00	1
5925.14	80.00	80.00	0.00	1
5930.00	182.33	182.33	0.00	Overtopping



Rating Curve Plot for Crossing: BRADLEY XING DUAL 42 CMP

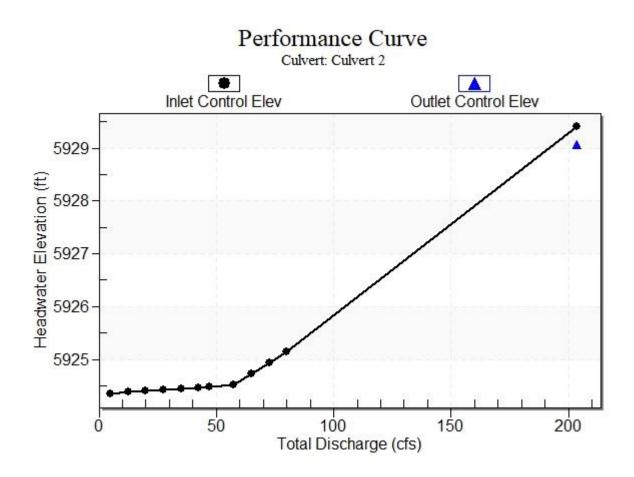
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	5924.35	2.347	0.0*	1-S2n	0.413	0.471	0.413	0.041	3.903	1.210
12.50	12.50	5924.38	2.379	0.0*	1-S2n	0.647	0.752	0.647	0.071	5.108	1.730
20.00	20.00	5924.40	2.405	0.0*	1-S2n	0.817	0.957	0.817	0.093	5.857	2.076
27.50	27.50	5924.43	2.427	0.0*	1-S2n	0.959	1.127	0.959	0.113	6.422	2.345
35.00	35.00	5924.45	2.448	0.0*	1-S2n	1.087	1.277	1.087	0.130	6.874	2.571
42.50	42.50	5924.47	2.467	0.0*	1-S2n	1.203	1.413	1.203	0.146	7.260	2.767
47.00	47.00	5924.48	2.478	0.0*	1-S2n	1.269	1.489	1.269	0.155	7.463	2.874
57.50	57.50	5924.53	2.525	0.0*	1-S2n	1.415	1.655	1.415	0.175	7.884	3.100
65.00	65.00	5924.73	2.730	0.0*	1-S2n	1.515	1.764	1.515	0.188	8.145	3.245
72.50	72.50	5924.93	2.934	0.0*	1-S2n	1.611	1.868	1.611	0.200	8.380	3.381
80.00	80.00	5925.14	3.139	0.0*	1-S2n	1.705	1.967	1.705	0.212	8.594	3.506

 Table 2 - Culvert Summary Table: Culvert 2

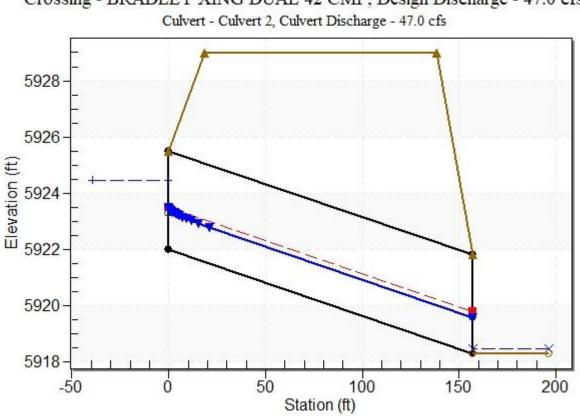
* Full Flow Headwater elevation is below inlet invert.

Straight Culvert Inlet Elevation (invert): 5922.00 ft, Outlet Elevation (invert): 5918.32 ft Culvert Length: 157.10 ft, Culvert Slope: 0.0234 Inlet Throat Elevation: 5922.00 ft, Inlet Crest Elevation: 5924.31 ft

Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Crossing - BRADLEY XING DUAL 42 CMP, Design Discharge - 47.0 cfs

Site Data - Culvert 2

Site Data Option: Culvert Invert Data Inlet Station: 0.00 ft Inlet Elevation: 5924.00 ft Outlet Station: 157.00 ft Outlet Elevation: 5918.32 ft Number of Barrels: 2

Culvert Data Summary - Culvert 2

Barrel Shape: Circular Barrel Diameter: 3.50 ft Barrel Material: Corrugated Steel Embedment: 0.00 in Barrel Manning's n: 0.0240 Culvert Type: Straight Inlet Configuration: Thin Edge Projecting Inlet Depression: Yes

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	5918.36	0.04	1.21	0.08	1.06
12.50	5918.39	0.07	1.73	0.13	1.16
20.00	5918.41	0.09	2.08	0.17	1.22
27.50	5918.43	0.11	2.34	0.21	1.25
35.00	5918.45	0.13	2.57	0.24	1.28
42.50	5918.47	0.15	2.77	0.27	1.31
47.00	5918.48	0.16	2.87	0.29	1.32
57.50	5918.49	0.17	3.10	0.33	1.34
65.00	5918.51	0.19	3.24	0.35	1.36
72.50	5918.52	0.20	3.38	0.38	1.37
80.00	5918.53	0.21	3.51	0.40	1.39

Table 3 - Downstream Channel Rating Curve (Crossing: BRADLEY XING DUAL 42)

CMP)

Tailwater Channel Data - BRADLEY XING DUAL 42 CMP

Tailwater Channel Option: Trapezoidal Channel Bottom Width: 100.00 ft Side Slope (H:V): 35.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0250 Channel Invert Elevation: 5918.32 ft

Roadway Data for Crossing: BRADLEY XING DUAL 42 CMP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5929.00
1	60.00	5930.00
2	120.00	5929.00
duran Cumba a an	Deviad	

Roadway Surface: Paved

Roadway Top Width: 120.00 ft

DIVERSION CHANNEL ANALYSES

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Hydraulic Analysis Report

Project Data

Project Title: Designer: Project Date: Friday, May 29, 2020 Project Units: U.S. Customary Units Notes:

Channel Analysis: North Diversion Channel 1

Notes:

Input Parameters

Channel Type: Trapezoidal Side Slope 1 (Z1): 4.0000 ft/ft Side Slope 2 (Z2): 4.0000 ft/ft Channel Width: 8.0000 ft Longitudinal Slope: 0.0309 ft/ft Manning's n: 0.0300 Flow: 38.0000 cfs

Result Parameters

Depth: 0.6444 ft Area of Flow: 6.8159 ft[^]2 Wetted Perimeter: 13.3136 ft Hydraulic Radius: 0.5119 ft Average Velocity: 5.5752 ft/s Top Width: 13.1550 ft Froude Number: 1.3650 Critical Depth: 0.7749 ft Critical Velocity: 4.4178 ft/s Critical Slope: 0.0158 ft/ft Critical Top Width: 14.20 ft Calculated Max Shear Stress: 1.2425 lb/ft^{*}2

Calculated Avg Shear Stress: 0.9871 lb/ft^2

FYI: This will need to be addressed with the preliminary/final drainage report. See the criteria below.

6.5.2 Channel Velocity

Concrete, riprap, or soil cement linings as approved by the City/County shall be used where channel bottom velocities exceed 6.0 ft/sec. Grass lined channels shall not be used where velocity exceeds permissible velocities in Table 10-4 or the Froude number is greater than 0.9 for the 100-year storm.

Channel Analysis: North Diversion Channel 2

Notes:

Input Parameters

Channel Type: Trapezoidal Side Slope 1 (Z1): 4.0000 ft/ft Side Slope 2 (Z2): 4.0000 ft/ft Channel Width: 8.0000 ft Longitudinal Slope: 0.0344 ft/ft Manning's n: 0.0300 Flow: 72.0000 cfs

Result Parameters

Depth: 0.8874 ft Area of Flow: 10.2487 ft[^]2 Wetted Perimeter: 15.3175 ft Hydraulic Radius: 0.6691 ft Average Velocity: 7.0253 ft/s Top Width: 15.0990 ft Froude Number: 1.5027 Critical Depth: 1.1205 ft Critical Velocity: 5.1482 ft/s Critical Slope: 0.0143 ft/ft Critical Top Width: 16.96 ft Calculated Max Shear Stress: 1.9048 lb/ft[^]2 Calculated Avg Shear Stress: 1.4362 lb/ft[^]2

Selected Profile: FHWA Profile (read-only)

Culvert Assessment Profiles

Culvert Assessment Profile Name: Standard (read-only)

Maximum Excavation Depth: 20 ft Maximum Shallow Cover: 4 ft Maximum Small Pipe Size: 36 in Minimum Manned Entry Size: 48 in

Riprap Classes

Riprap Name: CLASS I

Riprap Class: I

The following values are an 'average' of the size fraction range for the selected riprap class. d100: 12 in

d85: 9 in

d50: 6.5 in

d15: 4.5 in

Riprap Name: CLASS II

Riprap Class: II

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 18 in d85: 13 in d50: 9.5 in d15: 7 in

Riprap Name: CLASS III

Riprap Class: III

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 24 in d85: 17 in d50: 12.5 in d15: 9 in

Riprap Name: CLASS IV

Riprap Class: IV

The following values are an 'average' of the size fraction range for the selected riprap class. d100: 30 in

d85: 21 in d50: 15.5 in d15: 10.5 in

Riprap Name: CLASS V

Riprap Class: V

The following values are an 'average' of the size fraction range for the selected riprap class. d100: 36 in

d85: 25.5 in d50: 18.5 in

d15: 13 in

Riprap Name: CLASS VI

POND JCD-D OUTLET TO N. BRADLEY ROAD DITCH SINGLE 48" RCP CUVLERT

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 80 cfs

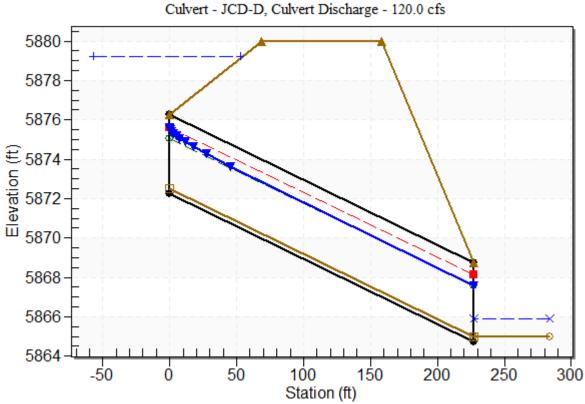
Design Flow: 120 cfs

Maximum Flow: 150 cfs

Headwater Elevation (ft)	Total Discharge (cfs)	JCD-D Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5876.84	80.00	80.00	0.00	1
5877.19	87.00	87.00	0.00	1
5877.57	94.00	94.00	0.00	1
5877.98	101.00	101.00	0.00	1
5878.41	108.00	108.00	0.00	1
5878.86	115.00	115.00	0.00	1
5879.21	120.00	120.00	0.00	1
5879.86	129.00	129.00	0.00	1
5880.03	136.00	131.20	4.42	16
5880.06	143.00	131.53	11.08	5
5880.08	150.00	131.79	17.74	4
5880.00	130.80	130.80	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: N. BRADLEY RD DITCH TO DP

Water Surface Profile Plot for Culvert: JCD-D



Crossing - N. BRADLEY RD DITCH TO DP JCD-D, Design Discharge - 120.0 cfs Culvert - JCD-D, Culvert Discharge - 120.0 cfs

Culvert Data Summary - JCD-D

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 3.00 in Barrel Manning's n: 0.0120 (top and sides) Manning's n: 0.0250 (bottom) Culvert Type: Straight Inlet Configuration: Square Edge with Headwall Inlet Depression: Yes

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
80.00	80.00	5876.84	4.339	0.0*	5-S2n	2.008	2.539	2.019	0.700	11.433	5.172
87.00	87.00	5877.19	4.694	0.0*	5-S2n	2.107	2.656	2.107	0.735	11.842	5.330
94.00	94.00	5877.57	5.073	0.258	5-S2n	2.205	2.768	2.205	0.769	12.163	5.478
101.00	101.00	5877.98	5.477	1.473	5-S2n	2.302	2.869	2.302	0.802	12.466	5.619
108.00	108.00	5878.41	5.908	2.228	5-S2n	2.398	2.966	2.398	0.834	12.754	5.754
115.00	115.00	5878.86	6.365	3.014	5-S2n	2.495	3.058	2.495	0.865	13.024	5.882
120.00	120.00	5879.21	6.708	3.553	5-S2n	2.564	3.114	2.564	0.887	13.207	5.969
129.00	129.00	5879.86	7.363	4.655	5-S2n	2.692	3.212	2.692	0.925	13.520	6.122
136.00	131.20	5880.03	7.530	4.834	5-S2n	2.723	3.236	2.723	0.954	13.593	6.234
143.00	131.53	5880.06	7.556	4.880	5-S2n	2.728	3.239	2.728	0.982	13.603	6.343
150.00	131.79	5880.08	7.576	4.917	5-S2n	2.732	3.242	2.732	1.010	13.612	6.449

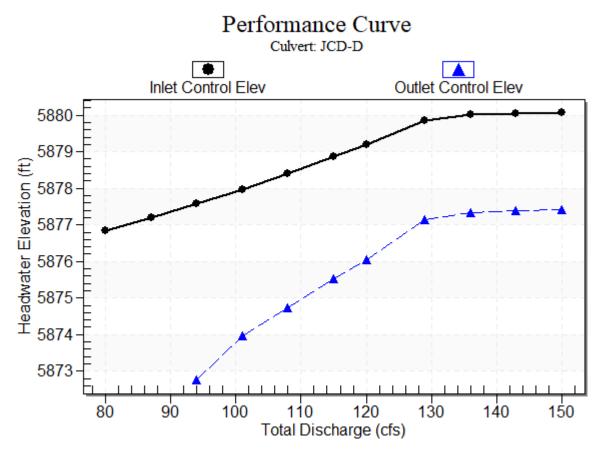
 Table 2 - Culvert Summary Table: JCD-D

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

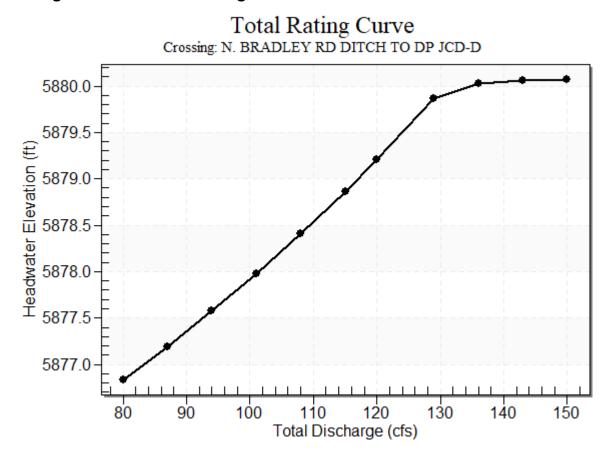
Inlet Elevation (invert): 5872.50 ft, Outlet Elevation (invert): 5865.00 ft Culvert Length: 227.14 ft, Culvert Slope: 0.0330 Inlet Throat Elevation: 5872.50 ft, Inlet Crest Elevation: 5873.13 ft

Culvert Performance Curve Plot: JCD-D



Site Data - JCD-D

Site Data Option: Culvert Invert Data Inlet Station: 0.00 ft Inlet Elevation: 5872.75 ft Outlet Station: 227.00 ft Outlet Elevation: 5864.75 ft Number of Barrels: 1



Rating Curve Plot for Crossing: N. BRADLEY RD DITCH TO DP JCD-D

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
80.00	5865.70	0.70	5.17	1.19	1.14
87.00	5865.74	0.74	5.33	1.25	1.15
94.00	5865.77	0.77	5.48	1.31	1.16
101.00	5865.80	0.80	5.62	1.37	1.16
108.00	5865.83	0.83	5.75	1.42	1.17
115.00	5865.87	0.87	5.88	1.47	1.18
120.00	5865.89	0.89	5.97	1.51	1.18
129.00	5865.93	0.93	6.12	1.58	1.19
136.00	5865.95	0.95	6.23	1.63	1.19
143.00	5865.98	0.98	6.34	1.67	1.20
150.00	5866.01	1.01	6.45	1.72	1.20

Table 3 - Downstream Channel Rating Curve (Crossing: N. BRADLEY RD DITCH TO

Tailwater Channel Data - N. BRADLEY RD DITCH TO DP JCD-D

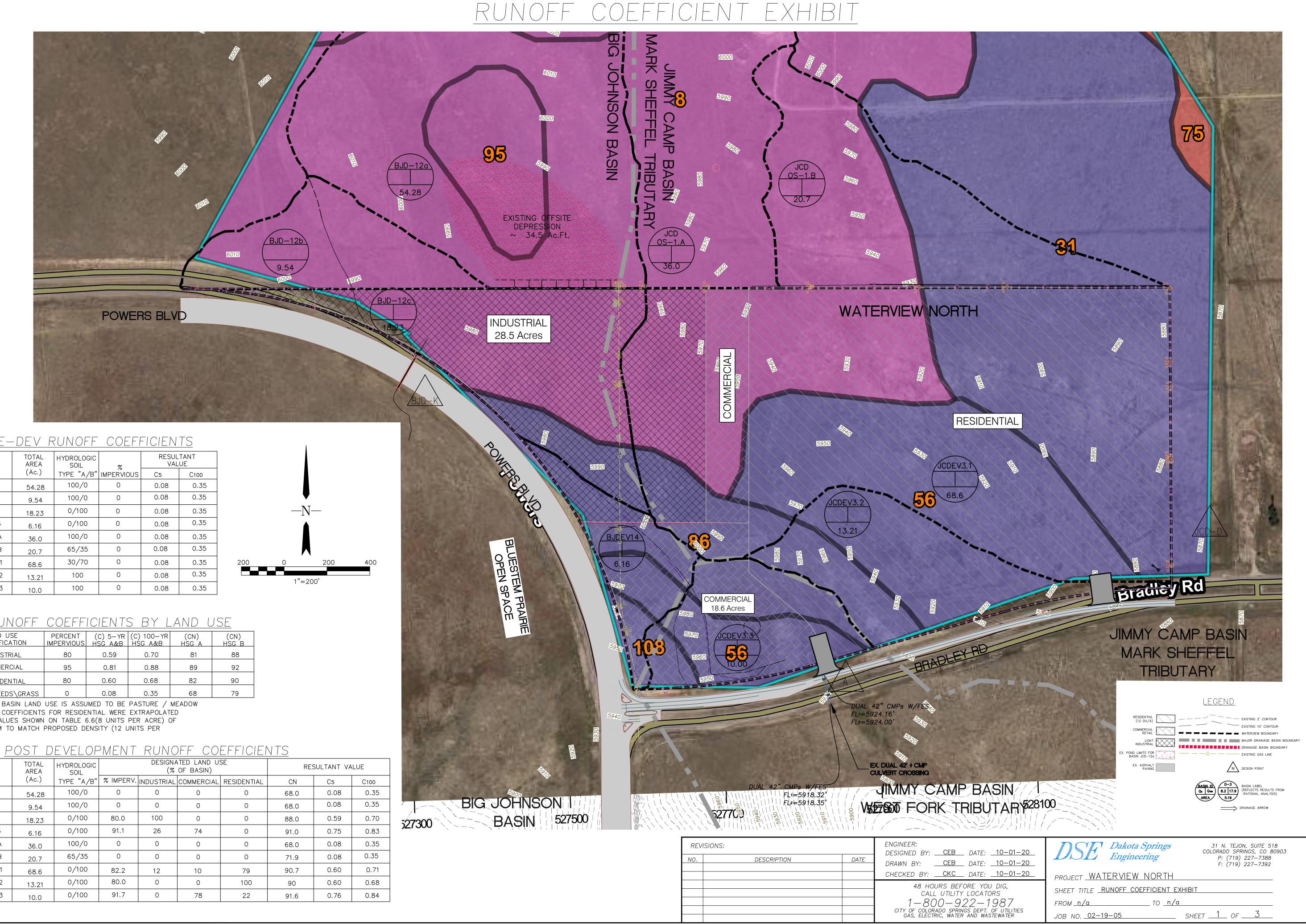
Tailwater Channel Option: Trapezoidal Channel Bottom Width: 20.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0273 Channel Manning's n: 0.0350 Channel Invert Elevation: 5865.00 ft

Roadway Data for Crossing: N. BRADLEY RD DITCH TO DP JCD-D

Roadway Profile Shape: Constant Roadway Elevation Crest Length: 333.00 ft Crest Elevation: 5880.00 ft Roadway Surface: Gravel Roadway Top Width: 90.00 ft

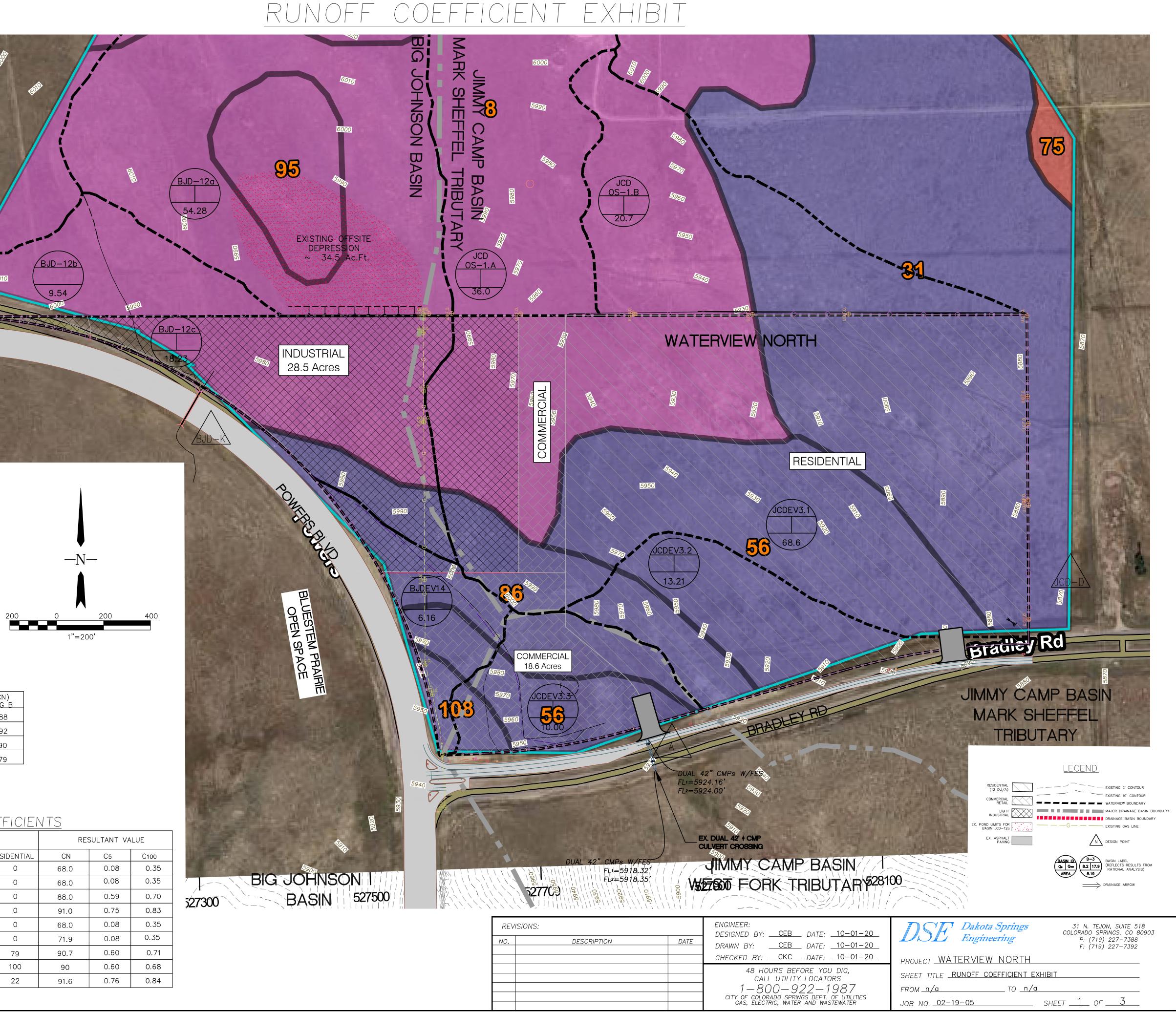
APPENDIX E

RUNOFF COEFFICIENT EXHIBIT PRE-DEVELOPMENT BASIN MAP POST DEVELOPMENT DRAINAGE PLAN



<u> PRE-DEV RUNOFF COEFFICIENTS</u>

BASIN ID	TOTAL AREA	HYDROLOGIC SOIL	%	RESULTANT VALUE		
	(Ac.)	TYPE "A/B"	IMPERVIOUS	C5	C100	
BJD-12a	54.28	100/0	0	0.08	0.35	
BJD-12b	9.54	100/0	0	0.08	0.35	
BJD-12c	18.23	0/100	0	0.08	0.35	
BJDEX-14	6.16	0/100	0	0.08	0.35	
JCD-OS1A	36.0	100/0	0	0.08	0.35	
JCD-OS1B	20.7	65/35	0	0.08	0.35	
JCDEX-3.1	68.6	30/70	0	0.08	0.35	
JCDEX-3.2	13.21	100	0	0.08	0.35	
JCDEX-3.3	10.0	100	0	0.08	0.35	

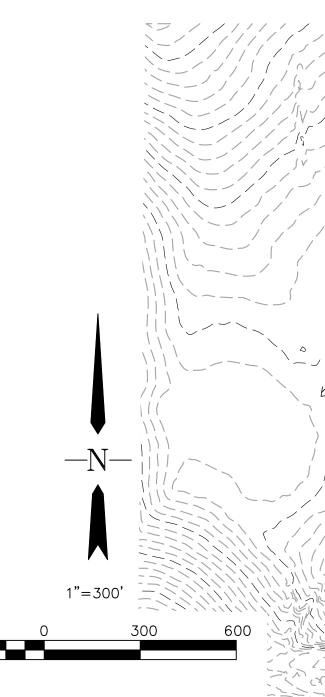


<u>RUNOFF COEFFICIENTS BY LAND USE</u>

LAND USE CLASSIFICATION	PERCENT IMPERVIOUS	(C) 5-YR HSG A&B	(C) 100-YR HSG A&B	(CN) HSG A	(CN) HSG B
INDUSTRIAL	80	0.59	0.70	81	88
COMMERCIAL	95	0.81	0.88	89	92
**RESIDENTIAL	80	0.60	0.68	82	90
*BRUSH\WEEDS\GRASS	0	0.08	0.35	68	79

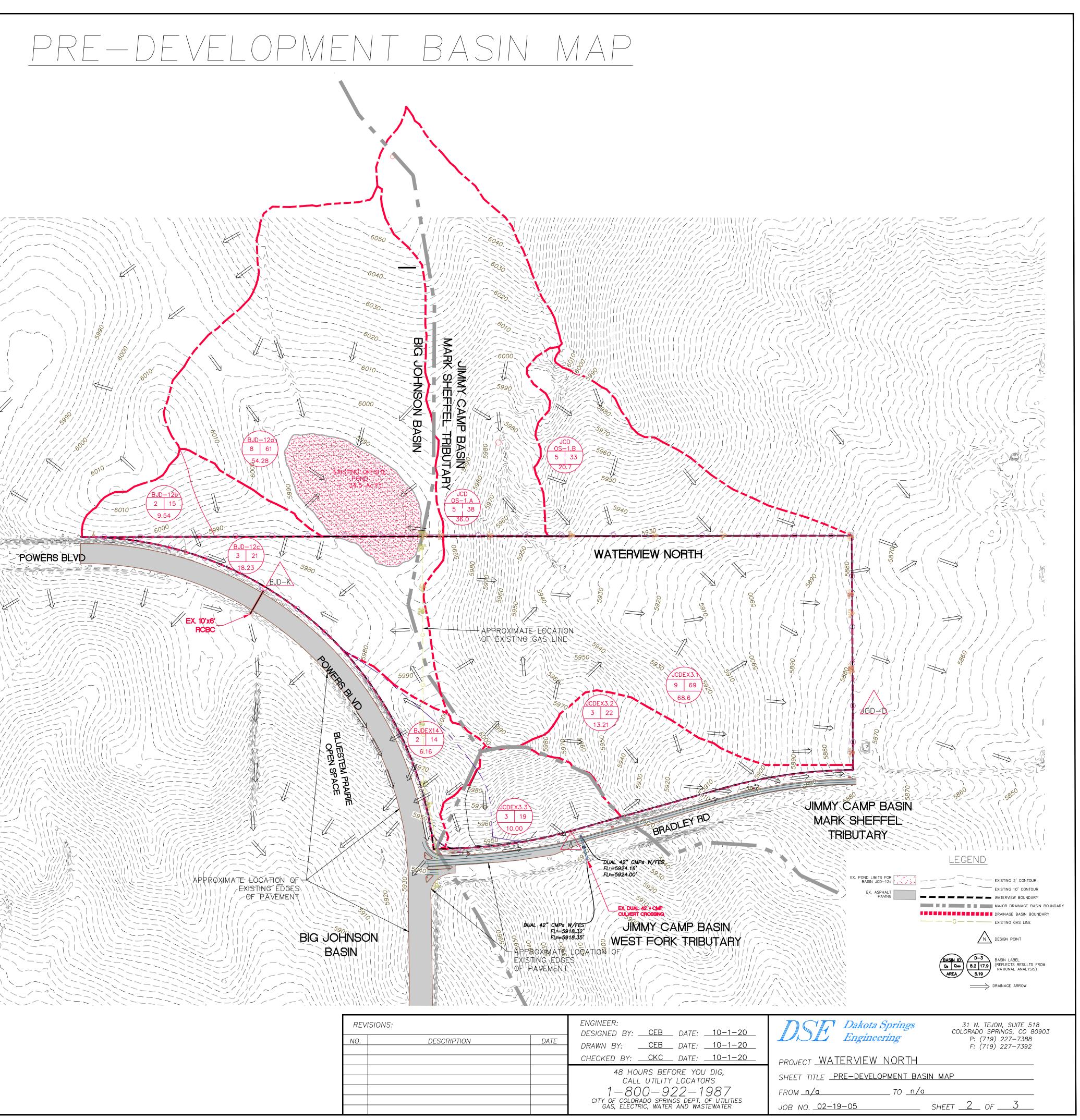
* OFFSITE BASIN LAND USE IS ASSUMED TO BE PASTURE / MEADOW ** RUNOFF COEFFICIENTS FOR RESIDENTIAL WERE EXTRAPOLATED FROM VALUES SHOWN ON TABLE 6.6(8 UNITS PER ACRE) OF THE DCM TO MATCH PROPOSED DENSITY (12 UNITS PER ACRE).

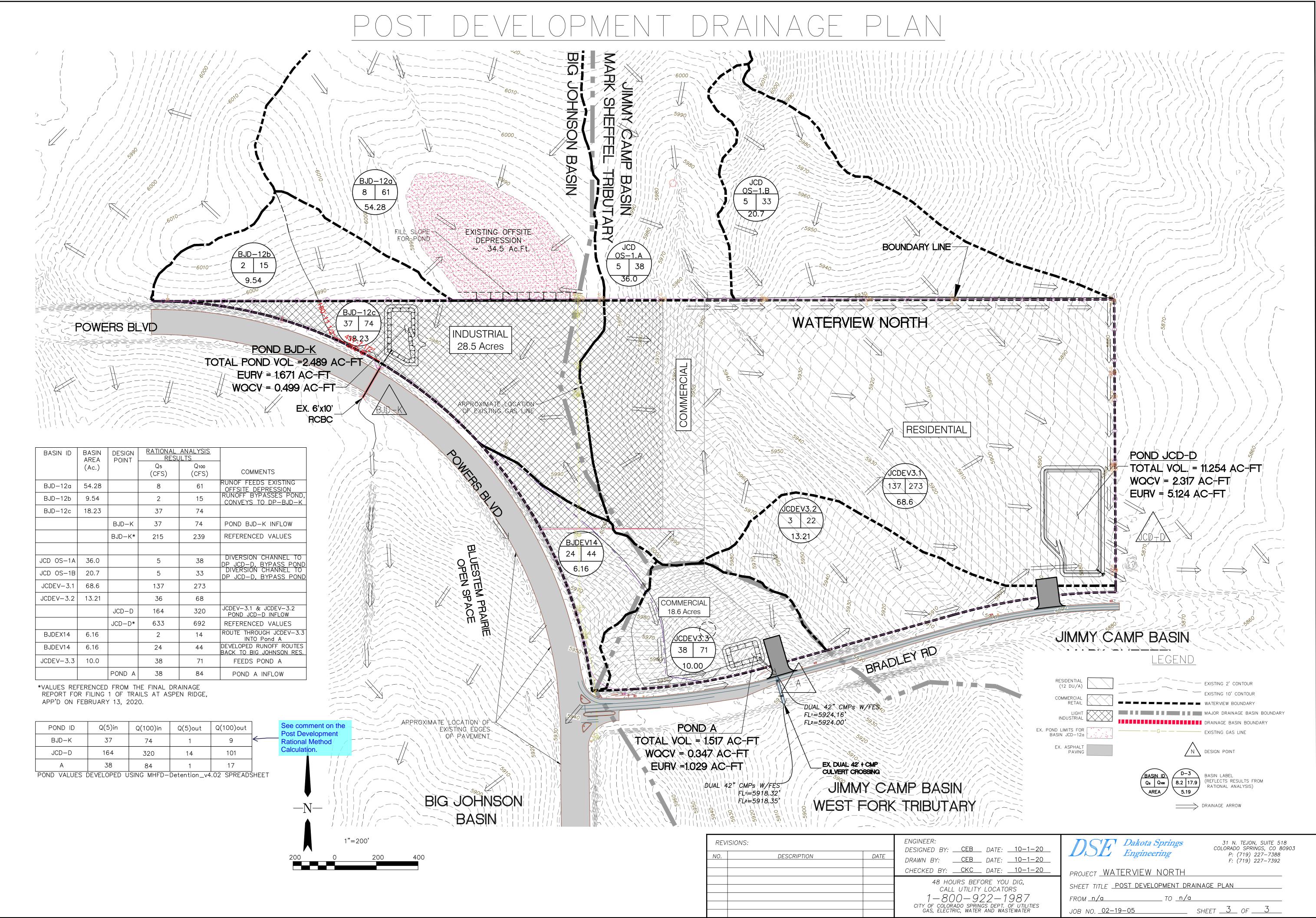
BASIN ID	TOTAL AREA	HYDROLOGIC SOIL		DESIGNA (%	TED LAND U OF BASIN)	SE	RESULTANT VALUE		
	(Ac.)	TYPE "A/B"	% IMPERV.	INDUSTRIAL	COMMERCIAL	RESIDENTIAL	CN	C5	C100
BJD-12a	54.28	100/0	0	0	0	0	68.0	0.08	0.35
BJD-12b	9.54	100/0	0	0	0	0	68.0	0.08	0.35
BJD-12c	18.23	0/100	80.0	100	0	0	88.0	0.59	0.70
BJDEV-14	6.16	0/100	91.1	26	74	0	91.0	0.75	0.83
JCD-OS1A	36.0	100/0	0	0	0	0	68.0	0.08	0.35
JCD-OS1B	20.7	65/35	0	0	0	0	71.9	0.08	0.35
JCDEV-3.1	68.6	0/100	82.2	12	10	79	90.7	0.60	0.71
JCDEV-3.2	13.21	0/100	80.0	0	0	100	90	0.60	0.68
JCDEV-3.3	10.0	0/100	91.7	0	78	22	91.6	0.76	0.84
		•		•	•				



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BASIN ID	BASIN AREA	DESIGN POINT	RATIONAL ANALYSIS RESULTS			
	(Ac.)		Q₅ (CFS)	Q100 (CFS)		
BJD—12a	54.28		8	61		
BJD-12b	9.54		2	15		
BJD-12c	18.23		3	21		
		BJD-K	4	31		
JCD OS-1A	36.0		5	38		
JCD OS-1B	20.7		5	33		
JCDEX-3.1	68.6		9	69]	
JCDEX-3.2	13.21		3	22		
		JCD-D	12	84		
JCDEX-3.3	10.0		3	19 🔹		
BJDEX14	6.16		2	14		Revise to match – JCDEX-3.3 (3, 1
		А	4	31 •	K	
		A*	5	25		

A* – MODELLED AS BASIN OS–1 IN THE FINAL DRAINAGE REPORT FOR FILING 1 OF TRAILS AT ASPEN RIDGE, APP'D ON FEBRUARY 13, 2020.





					_
POND ID	Q(5)in	Q(100)in	Q(5)out	Q(100)out	
BJD-K	37	74	1	9	<
JCD-D	164	320	14	101	
A	38	84	1	17	

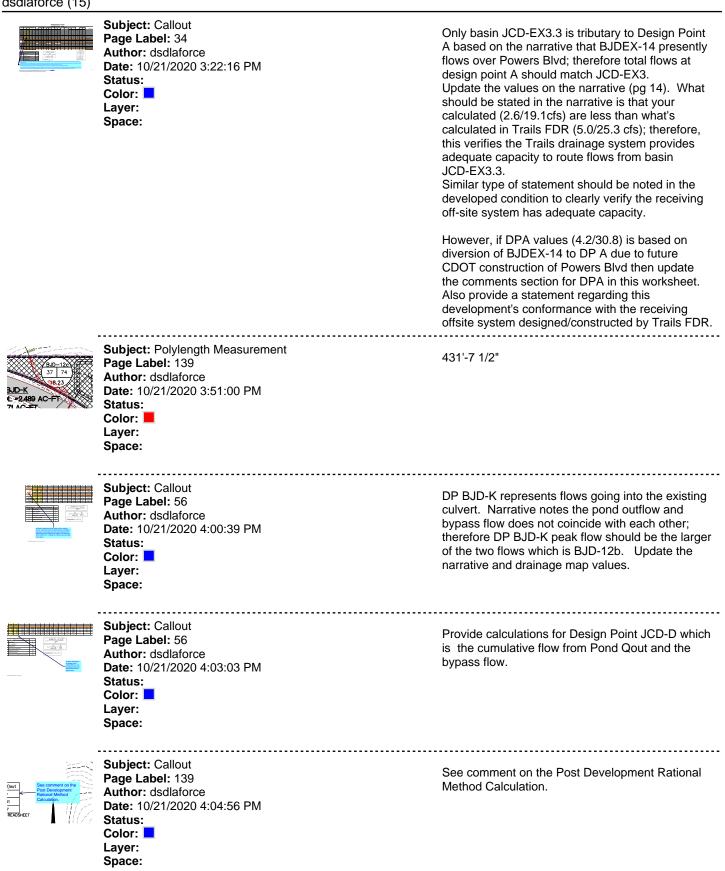


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MDDP_r2.pdf Markup Summary

dsdlaforce (15)



Activity of the second	Subject: Callout Page Label: 17 Author: dsdlaforce Date: 10/21/2020 4:23:31 PM Status: Color: Layer: Space:	Add bullet point
	Subject: Callout Page Label: 90 Author: dsdlaforce Date: 10/21/2020 4:47:06 PM Status: Color: Layer: Space:	See comment on page 15
The second	Subject: Callout Page Label: 86 Author: dsdlaforce Date: 10/21/2020 4:52:36 PM Status: Color: Layer: Space:	~ 1hr 15 min to 2hrs for peak flow. FYI: Preliminary drainage will have to show that the bypass hydrograph and pond hydrograph do not overlap.
	Subject: Cloud+ Page Label: 15 Author: dsdlaforce Date: 10/21/2020 4:54:42 PM Status: Color: Layer: Space:	Clarify. The developed drainage map is showing this basin is routed into Pond A. Update Pond A calculation to include basin BJDEV-14 for the pond sizing. However, if basin BJDEV-14 is supposed to have it's own wq/detention then show the pond on the proposed drainage map and provide the pond calculation. Assuming discharge is as shown on the proposed map then Pond A must be redesigned as a pond in a series.
<text><text><text><text><text><text></text></text></text></text></text></text>	Subject: Callout Page Label: 17 Author: dsdlaforce Date: 10/21/2020 4:56:00 PM Status: Color: Layer: Space:	Based on conversation with the design engineer there are two options being considered for basin JCDEV3.3. Rewrite narrative to clearly state that two options are currently being considered within JCDEV3.3. Recommend separating the two options into two bullet points similar to the above outfall alternative for pond D. For each option clearly identify the wq/detention for basin BJDEV14 since this basin is being routed through Pond A.
Image: Second	Subject: Callout Page Label: 92 Author: dsdlaforce Date: 10/21/2020 4:58:40 PM Status: Color: Layer: Space:	FYI: Final pond design will need this to be at 40hr

CMP CULVERT CROSSING RADLEY ROAD	Subject: Callout Page Label: 112 Author: dsdlaforce Date: 10/21/2020 5:02:26 PM Status: Color: Layer: Space:	Revise calculation. Per the narrative one is being plugged and the other is reduced.
A series and the series of the	Subject: Image Page Label: 121 Author: dsdlaforce Date: 10/21/2020 5:10:49 PM Status: Color: Layer: Space:	
A SIMPL THE STATE	Subject: Callout Page Label: 121 Author: dsdlaforce Date: 10/21/2020 5:11:18 PM Status: Color: Layer: Space:	FYI: This will need to be addressed with the preliminary/final drainage report. See the criteria below.
P P P P P P P P P P P P P P	Subject: Callout Page Label: 138 Author: dsdlaforce Date: 10/21/2020 5:16:03 PM Status: Color: Layer: Space:	Revise to match basin JCDEX-3.3 (3, 10)